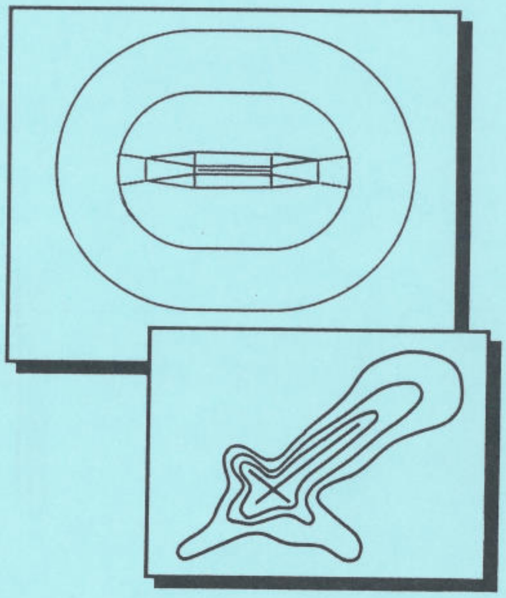
Airport Land Use Planning Handbook



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for
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Airport Land Use Planning Handbook

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Prepared for

California Department of Transportation
Division of Aeronautics

by

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Preface

HANDBOOK PREPARATION

The present volume constitutes a refinement of the *Draft* document which was circulated for review in September 1993. Many valuable questions, comments, and suggestions were submitted by the agencies and individuals who reviewed the draft. Numerous revisions, clarifications, and additions have been incorporated herein as a result.

The preparation of this *Airport Land Use Planning Handbook* is the outcome of 1990 state of California legislation (AB 4164) which directed the California Department of Transportation (Caltrans) Division of Aeronautics to:

> "...develop and implement a program or programs to assist in the training and development of airport land use commissions, after consulting with airport land use commissions, cities, counties, and other appropriate public entities."

This volume represents an update of an earlier *Handbook* published in 1983. Selected portions of the previous document are incorporated herein. For the most part, however, this 1993 version follows a different format and contains entirely new material. Most significant among the new material is the initial presentation of new research documenting the specific locations of aircraft accident sites with respect to the runway used.

Funding for preparation of this *Handbook* and the related accident location research was provided both by the state of California and a grant from the Federal Aviation Administration.

The *Handbook* was written under contract to the Division of Aeronautics by Hodges & Shutt, a Santa Rosa, California, aviation consulting firm. Associated with Hodges & Shutt on the project were: the Flight Safety Institute; Chris Hunter & Associates; and the University of California, Berkeley, Institute of Transportation Studies (ITS). ITS was responsible for preparation of the aircraft accident database noted above. Also, supporting the study team was an Advisory Committee specifically established for the project by Caltrans. The Advisory Committee, as listed on the back of the document title page, was composed of staff members from various airport land use commissions in the state along with other individuals involved in airport land use planning.

INTENT OF THIS DOCUMENT

The airport land use commission statutes are set forth in the State Aeronautics Act. The Act is codified as Division 9, Part 1, Chapter 4, Article 3.5 (Sections 21670 et seq.) of the California Public Utilities Code.

All references herein to sections of the California state law refer to the Public Utilities Code unless otherwise indicated.

The primary intent of this *Handbook* is to facilitate the job of airport land use commissions and their staffs in carrying out their duties as set forth in the California State Aeronautics Act. The document is also intended to help all parties involved in airport land use planning matters in California to better understand airport land use compatibility concepts and issues.

The information presented in this document is firmly based upon provisions of the Aeronautics Act pertaining to airport land use commissions. Many facets of airport land use planning are not clearly defined by law, however. There are many approaches which legitimately can and have been taken in the preparation of airport land use plans. These various approaches are discussed throughout this document and the tradeoffs among them are assessed. In some cases suggested or recommended approaches are stated. The emphasis, though, is more on examination of concepts and processes than it is on providing a *How-to-Do-It* guide to airport land use planning. In effect, the *Handbook* describes the *rules of the road*, but is not a *detailed map* of how to accomplish the task. To accomplish this latter step, each airport land use commission will need to take into account the specific circumstances of the airports and communities for which it is planning.

The basic approach to many of the airport land use planning issues discussed herein is a *pragmatic* one. This approach recognizes that compromises often are necessary between airport land use commissions' objectives of promoting a high degree of airport land use compatibility and the broader planning considerations and development needs of local communities. This approach is not meant to suggest, however, that any individual airport land use commission should back away from existing plans and policies which establish stronger compatibility criteria or procedures, especially if a high level of airport land use compatibility is supported by the communities involved.

Finally, it should be emphasized that the writing of this Handbook *has been the responsibility of Hodges & Shutt. Division of Aeronautics staff has reviewed the* Handbook *contents and generally finds the views of the authors regarding both Aeronautics law and procedure and airport land use planning practice to be consistent with the staff's interpretations. Nevertheless,* ***the views presented herein should be considered only as suggestions and recommendations****. The* Handbook *does* ***not*** *establish state standards or policies for airport land use planning. Also, the perspective herein is that of planning, not law. Readers of this document should consult with their respective legal counsels for interpretations of the law from a legal standpoint.*

DOCUMENT CONTENTS

This *Handbook* is organized into three parts:

- **Part I: ALUC Procedures and Plans** — This part begins with an examination of how airport land use commissions are structured and function. Factors to be considered in preparing airport land use compatibility plans and in formulating compatibility criteria and policies are discussed in the next two chapters. A fourth chapter outlines the process which ALUCs should follow in reviewing individual land use proposals. The final chapter addresses the important responsibilities which local agencies have in promoting airport land use compatibility. All of the chapters include extensive reference to the applicable sections of the state law.

- **Part II: Airport Land Use Compatibility Issues** — The four chapters in Part II assess the noise and safety compatibility concepts and issues which provide the basis for formulation of compatibility criteria and policies by individual ALUCs. The noise chapters review recent airport-related noise research and note the issues which are currently the subject of nationwide attention. No new research is presented, however. The safety chapters contain a summary of the new aircraft accident location research conducted by ITS. Some initial approaches to assessment and application of this data are outlined along with discussion of other safety compatibility issues.

- **Part III: Appendices** — The appendices contain various supporting and reference materials including a copy of the airport land use commission statutes of the Aeronautics Act. Samples of various materials which can or have been used by individual airport land use commissions are also included.

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Chapter 1

The Organization of Airport Land Use Commissions

1

The Organization of Airport Land Use Commissions

PURPOSE AND CREATION OF ALUCS

More than a quarter century has now passed since the California state legislature first enacted the portion of the state aeronautics law setting requirements for creation of airport land use commissions. The statutes governing airport land use commissions are set forth in Chapter 4, Article 3.5 (commencing with Section 21670) of the State Aeronautics Act (Division 9, Part 1 of the California Public Utilities Code).

A brief legislative history of airport land use commissions is included in Appendix A.

Amendments to the original 1967 law have been made about every two years since that time. Some of these amendments have involved relatively minor changes deemed necessary to respond to a particular issue or, in some cases, special circumstances in an individual county. Others have had the effect of causing major changes in the way airport land use commissions function. One of the most significant revisions was one approved as recently as July 1993. As of this writing, the creation of airport land use commissions is no longer mandated by the state, but is an option of local government.

Purpose

The California state legislature's purpose in authorizing the creation of airport land use commissions has remained largely unchanged since the early years of the statutes. This purpose is succinctly stated in the current law (Section 21670(a)):

- "It is in the public interest to provide for the orderly development of each public use airport in this state and the area surrounding these airports so as to promote the overall goals and objectives of the California airport noise standards adopted pursuant to Section 21669 and to prevent the creation of new noise and safety problems."

- "It is the purpose of this article to protect public health, safety, and welfare by ensuring the orderly expansion of airports and the adoption of land use measures that minimize the public's exposure to excessive noise and safety hazards within areas around public airports to the extent that these areas are not already devoted to incompatible uses."

Authority for Creation of ALUCs

An issue not explicitly addressed by the recent change in the law is what actions a county must take in order to disband an ALUC which is already in existence. A safe response to this question is that whatever actions were taken to create the ALUC in the first place would need to be reversed. For most ALUCs, this would mean that majorities of the board of supervisors of the county (or counties in the case of multi-county ALUCs), the selection committee of city mayors, and the selection committee of public airport managers would each have to terminate their appointments of individual commissioners and the disbanding of the commission itself. A county board of supervisors does not have the authority to unilaterally eliminate an ALUC.

The 1993 amendment to the state aeronautics law making creation of airport land use commissions optional was accomplished simply by changing the word "shall" in Section 21670(b) to "may." Now, a county *may* establish an ALUC if the county contains an airport which is:

- "Served by a scheduled airline;" or
- "Operated for the benefit of the general public."

The state law continues to include language allowing local entities the option of not establishing an ALUC if the county has no public-use airports which are served by a scheduled airline and none which are affected by any "noise, safety, or land use issues." Previously, to reach this conclusion, the county board of supervisors had to: consult with airport operators and affected local entities; hold a public hearing; and adopt a resolution supported by findings. These provisions now appear to have no significance.

COMMISSION FORMAT

For those counties which continue to have an airport land use commission, the law provides for two alternative formats. One is a separate entity with representation set in accordance with the provisions of the law. The other option is designation of another body, already existing for another purpose, to serve as the ALUC.

- **Separate Entity** — If established as a separate body, the standard membership composition of an airport land use commission consists of seven members selected as follows (Section 21670(b)):
  - Two county representatives (selected by the board of supervisors);
  - Two city representatives (selected by a committee comprised of the mayors of all cities in the county);
  - Two having "expertise in aviation" as defined in Section 21670(e) (selected by a committee of the managers of all public airports in the county); and

- One general public representative (selected by the other six commission members).

Provisions for minor variations to this composition are included in the law. These variations apply when there are no cities in the county (Section 21670(a)(1)) and/or when an airport is owned by another county or by a city or district in another county (Section 21671).

- **Designated Body** – If the board of supervisors and the mayors' committee in a county each determine that another body can accomplish the necessary airport land use planning, then such a body can be designated to assume the planning responsibilities of the airport land use commission and a separate commission need not be established. The designated body must have at least two members with aviation expertise or, when serving as the ALUC, be augmented to have two members thus qualified (Section 21670.1). Note that Section 21670(e) defines an elected official of a local agency which owns or operates an airport as a person having aviation expertise.

Table 1A summarizes the extent to which each ALUC format was in use as of July 1993. The table does not reflect changes which may occur as a result of the amendment which now makes ALUCs permissive.

Among California's 58 counties, all but one (San Francisco) contain a public-use airport and therefore could have an airport land use commission. As of July 1993, a total of 50 ALUCs existed in 54 counties. Of these, 28 were separate entities following the standard composition and 22 were designated bodies (including two regional planning agencies which provide the ALUC function for groups of counties).

AUTHORITY OF ALUCS

The airport land use planning authority of airport land use commissions is enumerated in various sections of the Aeronautics Act.

The statutory amendment making ALUCs permissive does not affect the commissions' powers and duties. If an ALUC is established, it still must function in the manner indicated by the law. On the other hand, if an ALUC no longer exists or was never formed, then the remainder of the ALUC statute as it currently stands has no direct applicability. Nevertheless, even in the absence of an ALUC, local governments continue to have basic duties to promote compatibility among all land uses, including airports. Some of these responsibilities are discussed in Chapter 5.

Powers and Duties

In the broadest sense, the law defines the powers and duties of ALUCs in terms which parallel the commissions' purpose:

> "To assist local agencies in ensuring compatible land uses in the vicinity of all new airports and in the vicinity of existing airports to the extent that the land in the vicinity of those airports is not already devoted to incompatible uses" (Section 21674(a)).

To fulfill this basic obligation, ALUCs have two specific duties:

- **Prepare Compatibility Plans** – Each commission is required to "prepare and adopt" an airport land use plan for each of the airports within its jurisdiction (Sections 21674(c) and 21675(a)).

Requirements and options regarding preparation of comprehensive land use plans are discussed in Chapter 2 of this *Handbook*. Review procedures are examined in Chapter 4.

- **Review Local Agency Land Use Actions and Airport Plans** — The commissions' second duty is to "review the plans, regulations, and other actions of local agencies and airport operators..." (Section 21674(d)). The nature of this review varies depending upon whether the commission has adopted a compatibility plan, as well as upon whether the general plan of the local agency is consistent with the commission's plan.

The law is less precise regarding how ALUCs are to go about each of these two tasks. Some of the law's provisions are mandatory; others leave substantial discretion to each individual commission. These topics are addressed in the respective chapters which follow.

Statutory and Practical Limitations on ALUCs

Just as important as the specified powers and duties of ALUCs are the limitations on their authority. Some of these limitations are explicitly noted in the statutes. Other limitations are more implicit or, in some cases, left unaddressed by the Aeronautics Act. Still others result mostly from practical factors involved with implementation of the law.

- **Airport Operations** — Section 21674(e) explicitly states that: "The powers of the commission shall in no way be construed to give the commission jurisdiction over the operation of any airport." The meaning of "operation of any airport" is left undefined. Clearly, any actions directed toward the day-to-day activities of an airport or the manner in which aircraft operate are beyond the purview of ALUCs. Equally clearly, ALUCs have authority to review proposed airport plans or development to the extent that such proposals could affect off-airport land uses. Less clear are the limitations on ALUCs' involvement in other facets of airport planning and development. In this regard, several questions can be posed:

  - *Can an ALUC prepare — rather than simply review — a long-range master plan for an airport?* The key word in this question is *prepare* as distinct from *adopt*. In order to carry out its compatibility planning duties, ALUCs sometimes may, as a practical matter, find it necessary to prepare certain components of a master plan. For example, 20-year activity forecasts and projected noise contours may not exist for some airports, especially small ones. Also, when no accurate layout plan exists for an airport, ALUCs may need to prepare a drawing documenting the physical configuration of existing facilities. ALUCs, though, have no authority to adopt, let alone implement, a master plan for an airport — only the owner/operator of the airport can do that. Furthermore, whenever no master plan has been adopted by the airport owner/operator, the ALUC's use of an airport layout plan for compatibility planning purposes must be approved by the Division of Aeronautics (Section 21675(a)).

Format[a]	Number of Counties	Number of ALUCs
Standard Composition	26	28[b]
Designated Body		
Regional Planning Agency	15	9
Airport Commission	3	3
Planning Commission	7	7[c]
Board of Supervisors	3	3
None		
No ALUC Established	3[d]	
No Airports	1	
Total	58	50

[a] As of July 1993.

[b] Including 3 separate ALUCs in San Bernardino County.

[c] Including 3 augmented with 2 members having aviation expertise.

[d] ALUCs in some of the counties counted above also essentially do not exist; that is, they have been formally established, but have never become or no longer are active.

Source: Data compiled by Hodges & Shutt (December 1993)

Table 1A

ALUC Formats

- *Can an ALUC modify an adopted airport plan to serve as the basis for its own plan?* As required for the purposes of compatibility planning, an ALUC can extend activity forecasts, update noise contours, and make necessary changes to plan drawings to reflect existing conditions. Any such modified plans must be approved by the Division of Aeronautics for use by the ALUC. An ALUC cannot add or delete proposed facilities from a locally adopted airport plan. Nor can an ALUC modify activity forecasts or noise contours in a manner which presumes a future mix of aircraft or other operational characteristics significantly different from those in the plan adopted by the airport's owner/operator.

- *Can an ALUC exercise review authority over on-airport plans or development which do not have off-airport compatibility implications?* An ALUC reviews airport master plans and certain other development plans for consistency with the commission's plan. The statutes give ALUCs no other authority to review on-airport development. This issue become muddied, however, when the on-airport development involves nonaviation facilities such as office or industrial buildings. Many ALUCs assert that they have the authority to review this type of development proposal in that it does not involve the "operation" of the airport. For public relations purposes if nothing else, airports probably should concede this point — it would be difficult to argue that certain nonaviation development should be allowed to occur on airport property when the same development in the same location would be judged incompatible if the property was privately owned.

A discussion of the practical aspects of ALUC involvement in issues other than noise and safety is included in Chapter 2.

- **Impacts Assessed** — Several sections of the law (most notably, the declaration of purpose, Section 21670(a)) refer to the commissions' authority to address noise and safety problems. This suggests that the law does not intend for ALUCs to address other types of airport land use compatibility issues such as air quality or ground access traffic. Nothing in the law specifically excludes ALUC consideration of such matters, however.

- **Geographic Jurisdiction** — Some airports have impacts which extend across county boundaries. The state law does not contain any provisions for dealing with such situations. However, the state Attorney General has concluded that the jurisdiction of an ALUC in which any such airport is located does *not* extend to an adjacent county where some of the impacts occur. (The one exception to this single-county limitation is where a multi-county regional planning agency serves as the ALUC for each county affected by the airport.) This limitation being the case, it would seem that an ALUC in the adjoining county should be able to conduct compatibility planning for the portion of the airport's impact area which crosses the county boundary. Neither the law nor the Attorney General's opinion are clear on this point, however.

Chapter 3 includes some insights into these issues.

- **Existing Land Uses** — ALUCs have no authority over existing land uses regardless of whether such uses are incompatible with airport activities (Sections 21670(a)(2) and 21674(a)). Left undefined by aeronautics law are such questions as:
  - When in the land use planning and development process does a proposed new land use effectively become an existing use?
  - To what extent, if any, can an existing use be modified or reconstructed without coming under ALUC review authority?

This topic is examined in the final portion of Chapter 3.

- **Extent of Restrictiveness** — Another issue not addressed by the ALUC law is the extent to which airport land use commissions can legitimately seek to restrict land uses around an airport even when such restrictions are necessary for noise and safety compatibility and have the support of the local agency having land use jurisdiction. This issue comes under the heading of inverse condemnation or *takings* and has been examined at length in other laws and in many court cases. In general, as long as the restrictions allow some remaining economically viable use of the land, a court will usually find them to be legitimate. However, an attempt by an ALUC to preclude all development from an area — the runway protection zones being the primary example — would undoubtedly be deemed a regulatory taking. Where prevention of all development is critical to the operation of an airport, it must be the responsibility of the airport owner to acquire the property or the development rights.

- **Plan Implementation** — ALUCs exercise approval authority over certain types of local government land use actions as specified in the Aeronautics Act. Also, local governments must abide by the provisions of the airport land use planning statutes. Nevertheless, the law only gives ALUCs powers to *assist* local agencies "in ensuring compatible land uses" (Section 21674(a)) and to *coordinate* compatibility planning efforts at the state, regional, and local levels (Section 21674(b)). ALUCs are not implementing agencies in the manner of local governments. Nor do they issue permits for a project such as those typically required both by local governments and various state and federal agencies. The ability of ALUCs to ensure implementation of its plans is thus limited from both a statutory and a practical perspective. For example:
  - Although local agencies must adopt findings and take other steps in order to override an ALUC decision, they often tend to overlook the fact that such findings cannot be adopted merely as matters of opinion, but instead must be supported by *substantial evidence*.
  - The question of a proposed land use's compatibility with an airport is often more a matter of degree than a clear, black-and-white issue. Consequently, local agencies' views of compatibility may be just as persuasive to a court as that of the ALUC. A court

decision thus will turn on the degree to which evidence is presented of consensus among airport and land use planners as to specific criteria for compatibility.

- Even when a local agency clearly stretches the concept of compatibility or otherwise ignores the intent of the state law, most ALUCs lack the political will and financial resources to challenge the agency's action.
- Lastly, from a practical standpoint, ALUCs rarely become aware that a local agency is intending to override a decision of the commission. The law does not require local agencies to notify the commission of such an intent. ALUCs thus seldom get the opportunity to argue their case before a county board of supervisors or city council prior to when the override action is voted upon.

Relationship to Other Local Government Bodies

Regardless of whether airport land use commissions are constituted in the standard manner or as designated bodies, they function as independent decision-making entities. In this respect, the authority of ALUCs is sometimes compared to that of local agency formation commissions (LAFCOs). The state law specifically establishes some of the relationships between ALUCs and other local government bodies, but leaves others undefined.

County Government

The relationship between an airport land use commission and the government of the county in which it is formed is perhaps the most often misunderstood. Even though most ALUCs operate under the auspices of county planning departments, the decisions of the commission are not subject to board of supervisors approval in order to take effect. This applies with respect to both of the commission's primary responsibilities – adoption of compatibility plans and review of local land use actions and airport plans. It also applies regardless of whether a separate ALUC has been established or some existing county agency such as a planning commission functions as a designated ALUC. A county must follow the same steps as a city if it wishes to override an ALUC decision.

The only area in which the Aeronautics Act does spell out county authority over an ALUC is with regard to expenditures and staffing. Any compensation for the commission members is determined by the board of supervisors (Section 21671.5(b)). Also, an ALUC cannot hire a staff or contractors without the prior approval of the board of supervisors (Section 21671.5(d)). Counties, though, are required to provide staff assistance for the operation of ALUCs (Section 21671.5(c)).

Regional Planning Agencies

Although the statutes do not explicitly say so, the above funding and staffing relationships between ALUCs and counties are, from a practical standpoint, inapplicable when a regional planning agency serves as a designated ALUC. Regional planning agencies have their own decision making bodies consisting of representatives of member governments — a county or counties and the cities within them. They also have their own control over expenditures and staffing.

RULES AND REGULATIONS

The discussion here addresses rules and regulations governing the general functioning of airport land use commissions. Procedures addressing the preparation of compatibility plans and the review of local projects are covered in Chapters 2 and 4, respectively.

The aeronautics law specifically gives ALUCs the power to adopt rules and regulations as necessary to carry out their responsibilities (Section 21674(f)). All airport land use commissions should exercise this power. Rules and regulations are particularly necessary for ALUCs established as separate entities. Commissions or other entities formed for other purposes, but designated to serve as airport land use commissions, may need to augment their rules and regulations to address topics specific to the powers and duties of ALUCs.

The substance of rules and regulations will largely be determined by local experience in the county where the ALUC is formed. The Aeronautics Act sets certain limitations on how ALUCs can conduct business (mostly in Section 21671.5), but does not require that these subjects be addressed in adopted rules and regulations. The only topic which must be covered is conflicts of interest.

The following topics are drawn from various sections of the Aeronautics Act as well as from other state laws and the rules and regulations adopted by individual ALUCs in the state. They are listed here as examples of topics which can be included.

Meetings

Normally, ALUC meeting procedures should follow those of the county or designated body under which the commission is organized. Such procedures include: notice of meetings and special meetings; conduct of business; election of officers; open meeting requirements (Brown Act); holding of public hearings; recording of minutes; etc. Among meeting procedures which may be particular to ALUCs are these:

- **Frequency** — The law states that "the commission shall meet at the call of the commission chairperson or at the request of the majority of the commission members" (Section 21671.5(e). Many ALUCs have an established monthly meeting schedule. However, once an ALUC has adopted a compatibility plan for each of its airports and the affected local plans have been determined to be consistent with it, the types of projects subject to future review are greatly reduced and the need for regular meetings may largely disappear.

- **Quorum** – A majority of the commission's membership normally comprises a quorum for the purposes of conducting business. Proxies (see following discussion) present at a meeting in place of a regular member should be counted when determining the existence of a quorum.

- **Conflicts of Interest** – Section 21672 of the aeronautics law requires that commissions "adopt rules and regulations with respect to the temporary disqualification of its members from participating in the review or adoption of a proposal because of a conflict of interest..." For guidance as to what circumstances constitute a conflict of interest, reference must be made to other state laws; the subject is not further addressed by the Aeronautics Act. In general, a *personal financial interest* in an action would present a conflict of interest on the part of an ALUC member.

  Some ALUCs also consider a commissioner's participation as a member of another agency in prior action on an issue before the commission to represent a conflict of interest. The rationale for disqualification under these circumstances seems questionable, however, especially considering that the commission's members serve as *representatives* of their appointing entities.

Duties of Members

Term of Office

The members of an airport land use commission organized with a standard composition each serve four-year terms. All terms are to end on the first Monday in May, but are to be rotated so that one or two terms expire each year (Section 21671.5(a)). Members serve at the pleasure of the appointing body and may be removed by that body at any time and for any reason. The terms of office for the members of a designated body serving as an ALUC normally follow those of the designated body.

Officers

ALUC rules and regulations should indicate what offices are to be established on the commission, what the duties of each officer are, and when new officers are to be selected. A designated body serving as an

ALUC usually keeps the same officers when sitting as an ALUC as it has when convened in its regular capacity.

Appointment of Proxies

In addition to an ALUC's regular members, state law provides for the appointment of proxies. Each member is required to appoint a proxy who "shall serve at the pleasure of the appointing member." A signed document designating the proxy is to be kept on file at the commission offices. The proxy represents the regular commission member and is empowered "to vote on all matters when the member is not in attendance" (Section 21670(d)). However, in order to vote on a matter discussed at a previous meeting, a proxy should be current on the documents and issues involved.

The law is silent with respect to the appointment of proxies on designated bodies which serve as an airport land use commission.

Responsibilities of Staff

ALUCs may wish to include a statement of staff duties and responsibilities in the commission rules and regulations. Among the duties usually delegated to staff are:

- Coordinating with local agency staff to obtain information regarding specific projects to be reviewed by the ALUC;
- Providing general assistance to local agency staff regarding airport compatibility issues;
- Preparing staff reports and meeting agendas;
- Issuing required public notices of pending commission actions;
- Recording meeting minutes; and
- Notifying local agencies of commission decisions on items submitted for review.

Some ALUCs also give staff significant discretion regarding which proposed local projects and other actions are brought to the commission for review and when. This particularly applies when review of the proposed project is not required by law, but may be covered under a review agreement between the ALUC and local agencies. Any proposed project formally submitted for review should be brought to the commission for action.

Fees

As further discussed in Chapter 4, the state law (Section 21671.5(f)) allows commissions to charge project proponents for the cost of project reviews. The fee structure and the method and timing of collection are appropriate subjects for ALUC rules and regulations.

Chapter 2

Preparation and Content of Compatibility Plans

2

Preparation and Content of Compatibility Plans

PURPOSE OF COMPATIBILITY PLANS

The state Aeronautics Act mostly refers to these documents as *comprehensive land use plans* or CLUPs, although the term *airport land use plan* is also used. These and other titles — for example, *airport land use compatibility plan*, *airport land use policy plan*, *airport environs land use plan* — are found among the plans prepared by the various county airport land use commissions. Regardless of the name, all are intended to serve the same purpose and must conform to the state law requirements. The generic term *compatibility plan* is used in this *Handbook*.

In counties which choose to establish and maintain a functioning airport land use commission, state law requires that the commission prepare compatibility plans for the public-use airports within its jurisdiction (Section 21675(a)). Compatibility plans are the fundamental tool used by airport land use commissions in fulfilling their purpose of promoting airport land use compatibility. The law describes the purpose of these plans in essentially the same terms as it uses with respect to the purpose of the commissions themselves. Specifically, compatibility plans have two purposes:

- To "provide for the orderly growth of each public airport and the area surrounding the airport within the jurisdiction of the commission ..." and
- To "safeguard the general welfare of the inhabitants within the vicinity of the airport and the public in general."

This chapter examines how compatibility plans are prepared, what should be included in them, and the process involved in their adoption.

PLAN DEVELOPMENT PROCESS

Plan Preparation

The responsibility for adopting compatibility plans belongs to each airport land use commission. The process by which these plans come to be prepared varies, however.

- **Plans Prepared by ALUCs** – Most compatibility plans are prepared either by the commission staff or by consultants under contract to the county or regional planning agency within which the commission operates. This approach generally gives the commission and its staff the most direct involvement in the plan's format and policies.

- **Plans Prepared as Part of Larger Plans** – Other compatibility plans are developed as a component of larger planning studies conducted by other agencies rather than under the direction of the ALUC. Examples of this process include compatibility plans prepared as part of a *master plan* for an individual airport or a *specific plan* for the portion of a community around an airport. When formatted in either of these ways, the airport land use commission may only need to adopt the portion which constitutes the compatibility plan. All of the essential elements of a compatibility plan should be included, however.

Information Resources

In addition to these basic reference sources, the *airport master plans* (AMPs) and *airport layout plans* (ALPs) prepared for individual airports and the *air installation compatible use zone* (AICUZ) plans developed for military airfields are essential sources of information needed in the preparation of compatibility plans. Federal Aviation Regulations Part 150 *Airport Noise Compatibility Planning* studies for individual airports also may contain information useful to development of compatibility plans. Refer to Appendix F for a list of reference documents mentioned in this *Handbook*.

A variety of information resources are available to help ALUCs and their staffs with the process of preparing compatibility plans. Among the most important of these are the following:

- **ALUC Handbook** – One of the purposes of this *Handbook* is to serve as a source of information regarding compatibility plans and policies. Many of the problems and issues faced by ALUCs when preparing, using, and updating their plans are addressed herein.

- **State Aeronautics Staff** – The Caltrans Division of Aeronautics staff is available to respond to inquiries regarding state law, compatibility criteria, review procedures, and any other matters involving airport land use commissions.

- **Consultants** – Airport and land use planning consultants often provide services to ALUCs, including drafting of compatibility plans.

- **Other ALUCs** – The experience of other ALUCs is another valuable planning resource. Copies of adopted plans generally can be obtained from individual commissions. Also, commission members and their staffs are usually willing to discuss particular issues which they have faced. The Division of Aeronautics maintains a list of contact persons and phone numbers for each of the airport land use commissions in the state.

- **Seminars and Workshops** – ALUC seminars and workshops, such as the training sessions planned in conjunction with preparation of this *Handbook*, may continue to be held periodically by Caltrans or other organizations. These gatherings of airport land use commission members, staffs, and others involved in airport land use planning facilitate the exchange of information about compatibility planning issues.

Funding for Plan Preparation

Obtaining funds with which to prepare and/or update compatibility plans is an on-going problem for the majority of ALUCs. Sources of funding which the commissions in various counties have drawn upon include:

Beginning with the 1994 program year, preparation of master plans and layout plans for publicly owned airports is also eligible for state funding (through both CAAP grants and annual grants).

- **State Funding** – The Division of Aeronautics has provided grants to local agencies for the preparation of many countywide compatibility plans. This funding has primarily come from California Aid to Airport Program (CAAP) grants – which cover 90% of the cost of the plan preparation – but some airports have used their $5,000 ($10,000 beginning in fiscal 1994) annual grants for this purpose. However, with the state's on-going budgetary problems, the continued availability of funds from this source is uncertain. The principal reason for the July 1993 state law change which made formation of ALUCs optional was budgetary in nature. This change eliminated the applicability of the state law which requires the state to reimburse local governments for the cost of state-mandated local programs.

Also beginning with the 1994 California fiscal year, the state will assist local agencies with funding of the local share of FAA grants for airport and aviation purposes by contributing up to 5% of the federal grant amount.

- **Federal Funding as Part of an Airport Master Plan Study** – Another option for funding of a compatibility plan is as the land use component of an airport master plan. In this context, preparation of the compatibility plan can be eligible for federal funding under the Federal Aviation Administration's Airport Improvement Program. A limitation of this funding source, however, is that it generally allows preparation of a compatibility plan for only a single airport rather than a plan which is countywide in scope.

- **Local Funding as Part of Local Plan Preparation** – Some compatibility plans are prepared in conjunction with the preparation or updating of a community general plan or specific plan. Local general funds or other fund sources used for the community plan cover the incremental cost of the compatibility plan.

State subvention funds are available to transportation planning agencies for transportation planning purposes. Preparation of compatibility plans and other ALUC activities are eligible items.

- **Other Local Funds** – Other local fund sources for preparation of a compatibility plan include direct use of the general fund, airport-derived revenues (particularly at larger airports), state local assistance planning funds (state subvention funds), and, primarily with respect to amendments, ALUC fees for review of projects.

PLAN SCOPE

The defined scope of a compatibility plan should be clearly stated near the front of the plan document.

In order to prepare a compatibility plan, the first step is to determine the scope of the plan with respect to:

- Which airports are to be included (if the document covers more than one airport);
- What assumptions are to be made about the future of each airport;
- The types of airport impacts to be addressed;
- ALUC review of airport plans; and
- The extent of the geographic area to which the plan applies.

State law provides partial guidance regarding each of these factors.

Which Airports to Include

Which Types

The requirements as to which airports should have a compatibility plan are found in the law as follows:

An important distinction here is that the airport need not be publicly *owned* to necessitate preparation of a compatibility plan, only publicly *used*. See the Glossary for definitions of *public-use* versus other categories of airports.

- **Public-Use Airports** – A compatibility plan must be formulated for "each public airport" (i.e., each airport served by a scheduled airline or operated for the benefit of the general public) within the jurisdiction of the commission (Section 21675(a)). This requirement is clearly applicable to all *existing* public-use airports. ALUCs, though, have also developed compatibility plans for *proposed* public airports.
- **Military Airports** – Commissions have the option of whether or not to develop a compatibility plan for any federal military airport in their jurisdiction (Section 21675(b)).

Refer to the Glossary (Appendix G) for definitions of these types of airports.

- **Other Airports** – The law does not address the question of planning for areas around other types of airports including special-use and personal-use airports, agricultural landing fields, seaplane landing sites, and heliports. Many commissions, however, prepare compatibility plans for special-use airports and heliports. It is the opinion of the legal counsel to the Division of Aeronautics that compatibility plans are required for special-use airports and heliports. Also, special-use facilities are subject to the same state airport permit requirements – and the associated requirement for ALUC review of airport plans – as are public-use facilities.

How Many

Compatibility plan documents can be formatted to include only one airport or to cover all of the airports located within a commission's jurisdiction. Each of these two approaches has its advantages and disadvantages and neither is regarded as being superior to the other.

- **Individual Airport Plans** – Some ALUCs have separate compatibility plan documents for each of the airports within their jurisdiction. This approach allows the plan to focus on the specific issues relevant to the individual airport and its surrounding land uses and local jurisdictions. It is the format which normally results when the compatibility plan is prepared as an element of an airport master plan or local specific plan.

- **Countywide Plan** – Other commissions have prepared a single document in which the compatibility plans for each of the airports are collected. This format promotes consistency among the policies for all of the airports in the commission's jurisdiction.

Airport Plan and Activity Assumptions

The state law provision allowing an ALUC's compatibility plan to be based upon an airport layout plan, with the approval of the Division of Aeronautics, was added in 1990. The change was the result of a Riverside County court case (*City of Coachella v. Riverside County Airport Land Use Commission*, 210 CalApp.3d 1277) which voided a compatibility plan because it was not based upon an airport master plan as the law previously required.

By law, a compatibility plan "shall include and shall be based on a long-range master plan or an airport layout plan, as determined by the Division of Aeronautics of the Department of Transportation, that reflects the anticipated growth of the airport during at least the next 20 years" (Section 21675(a)).

In practice, the Division of Aeronautics has applied the "as determined by" portion of this requirement as follows:

- **Adopted Master Plan Exists** – The Division generally does not become involved when a long-range master plan has been adopted by the agency owning the airport and the plan is reasonably current. It is important to emphasize that, when an adopted master plan exists, the law states that the commission's compatibility plan "shall be based" on that plan. When formulating a compatibility plan, it is not within the purview of the commission to add to or subtract from the proposed facilities shown in an adopted master plan. However, it may be necessary for an ALUC to update a plan drawing in order to show changes to existing facilities. Also, activity forecasts may need to be extended to encompass a time frame of at least 20 years.

- **Airport Layout Plan Available** – When a master plan does not exist or was never adopted by the airport owner, but an airport layout plan is available, the Division of Aeronautics will review the plan and any associated activity projections for currency and suitability for air-

ALUCs which have developed compatibility plans for airports not having an adopted master plan should make certain that the Division has a current layout plan on file for those airports and should seek the Division's acceptance of that plan for compatibility planning purposes. ALUCs also are encouraged to readopt the affected compatibility plans and indicate that these plans are based upon state-approved airport layout plans.

Also see discussion under *Statutory and Practical Limitations on ALUCs* in Chapter 1.

port land use planning purposes. The Division may suggest modifications to the plan if deemed necessary.

- **No Airport Plan Exists** — When no plan exists, the commission typically will need to prepare a simplified airport layout plan on which to base its land use compatibility plan. Because this situation mostly occurs only with regard to small, low-activity airports for which few changes are anticipated, the plan may merely need to reflect the existing conditions. Division of Aeronautics approval of these substitute airport layout plans is necessary.

In any instance requiring a determination by the Division of Aeronautics, the ALUC staff or consultant should submit the alternative airport plans to the Division as early in the compatibility planning process as is practical. Any necessary revisions to the airport plan can thus be taken into account before significant ALUC staff time is spent in the preparation of the compatibility plan.

Types of Compatibility Concerns

A more comprehensive review of the types of compatibility concerns addressed by airport land use compatibility plans is presented in Chapter 3.

As noted in Chapter 1, the focus of ALUC compatibility concerns is clearly on broadly defined noise and safety impacts. Other compatibility factors typically are issues only at large, primarily major airline, airports. So far, no ALUCs have established policies addressing issues not directly related to noise and safety, although occasionally such issues have arisen in the discussion of individual land use actions or airport master plans.

The practical aspect of an ALUC becoming involved in other types of airport impacts is that the commission would have little established guidance from other sources upon which to base its development of review criteria. Lacking such criteria, the commission would have nothing against which to evaluate a proposed local plan, project, or other action. Given these circumstances, ALUCs would be well advised to generally avoid other types of airport compatibility issues at least until such time as standards evolve to show the connection between the other impacts and the two basic purposes for creation of ALUCs.

Approaches to addressing these concerns are outlined in Chapter 3. Also, Part II of the *Handbook* contains an extended background discussion of noise and safety compatibility concepts and issues.

The two broad noise and safety categories of airport impacts both have individual components which should be considered in preparation of a compatibility plan.

- **Noise Impacts** — Airport *noise* compatibility is primarily assessed in terms of cumulative noise level contours such as those computed by the Community Noise Equivalent Level (CNEL) methodology. Noise exposure in areas beyond the outermost contours may also be of significance, however. These can generally be described under the heading of *overflight* impacts.

- **Safety Impacts** — Land-use-related airport safety concerns typically are divided into two groups:
  - Concerns directed toward minimizing the severity of an aircraft accident by limiting the types of land uses near an airport. (Most compatibility plans simply list this concern under the heading of *safety*.)
  - Concerns regarding land uses that can create hazards to flight. The *height of objects* on the ground is the principal example.

Planning Area Boundaries

Chapter 3 contains a discussion of factors to be considered in defining the planning area boundary.

State law (Section 21675(c)) requires that ALUCs establish planning area boundaries "after hearing and consultation with the involved agencies." Many ALUCs call these boundaries *airport areas of influence* or *airport influence areas*. They are also sometimes called *referral area boundaries* in that they set the limits of the area within which proposed land use projects are to be referred to the commission for review.

With certain exceptions, planning area boundaries are determined by:

- The location and configuration of the airport or airports included in the plan; and
- The extent of the noise and safety impacts associated with each airport.

The principal exception is that, with respect to review of proposals for new airports, the geographic scope of ALUC responsibilities extends to anywhere within the county or counties of the ALUC's jurisdiction. Some ALUCs also extend their planning area boundaries to include review of proposed construction, regardless of proximity to an airport, when such construction requires Federal Aviation Administration airspace hazard review under Part 77 of the Federal Aviation Regulations (when not near an airport, such objects generally must be more than 200 feet tall).

Types of Actions Reviewed by ALUCs

Chapter 4 describes the conditions under which review of specific types of actions in each of these groups is required or mandatory. The factors which an ALUC should examine in each of these reviews is addressed in that chapter as well.

Review of local actions pertaining to airport land use compatibility is one of the fundamental reasons for the formation of ALUCs. These local actions fall into two broad groups:

- Local land use plans, projects, and related actions; and
- Airport and heliport plans, including master plans, expansion plans, and plans for construction of a new facility.

In order to effectively review these proposed plans, projects, and actions when received, ALUCs should establish procedures and policies which provide a basis for the review. Also, these procedures and policies should explicitly list the types of actions which are to be reviewed by the commission and under what circumstances.

TYPICAL CONTENTS

The contents of airport land use compatibility plans vary considerably from one ALUC to another. However, certain essential elements are, or should be, included in every plan. Other elements fall into an optional category.

Essential Elements

All ALUC compatibility plans should include the elements described in this section.

As indicated by the preceding discussion in this chapter, state law says more about the substance of compatibility plans than it does about the specific components or their arrangement. The listing in this section is therefore based not only upon the law itself, but upon the typical contents of the plans which ALUCs have prepared.

- **Scope of the Plan** — Most plans begin with some type of statement regarding the plan's scope. A clear statement of its scope helps in drafting of the plan and is essential to the readers' understanding of what the plan is all about. Among the specific topics which should be covered are the following ones discussed earlier in this chapter:
  - *Authority and Purpose* — Brief reference should be made to the state statutes which authorize establishment of airport land use commissions and require the commissions to prepare compatibility plans. Quoting or mentioning the basic purpose of ALUCs, as set forth in Section 21670(a)(2), is also a useful way of placing the plan in its broader legislative and planning context. The plan's purpose can be defined in terms of its intended uses and objectives.
  - *Airport Identification* — If the plan addresses more than one airport, the names of the ones covered should be listed. This identification of airports is particularly important when a county contains military or special-use airports which may or may not be subjects of the plan.
  - *Geographic Coverage* — A general indication of the geographic extent of the plan should be provided early in the document. A more detailed delineation of planning area boundaries, as required by the statutes (Section 21675(c)), normally will be included in the policies section.

- *Jurisdictions Affected* — The local jurisdictions — the county and the specific incorporated cities — which are affected by the provisions of the plan should be identified in the document. The relationship of the ALUC's plan to the plans of local jurisdictions also may be valuable to describe.

- *Limitations of the Plan* — An effective way of further defining the scope of the compatibility plan is to indicate what the plan is not. At a minimum, the plan should note the limitations on ALUC jurisdiction over existing land uses and airport operations as stated in the law and interpreted by the individual ALUC.

- **Airport Information** — The compatibility plan must contain information about the subject airport(s) as necessary to document that the compatibility plan is based upon an adopted airport master plan or Caltrans-approved airport layout plan. *The emphasis in the information provided should be on aspects of the airport plan which affect off-airport land use compatibility.*

  - *Planning Status* — The master plan adoption date or, alternatively, documentation of Division of Aeronautics approval of an airport layout plan for use as the basis of the compatibility should be indicated.

  - *Layout Plan* — A drawing should be included which shows, at a minimum, the configuration and dimensions of the runways, size and shape of runway protection zones, and location of airport boundaries. Planned changes to any of these airport components should be depicted. This drawing can be a copy of the official airport layout plan or a more schematic scale drawing such as the one included on FAA *Airport Master Record* (5010) forms.

  - *Airport Activity* — Existing and projected airport operational levels need to be documented. Data should be included which indicates the known or estimated distribution of operations by type of aircraft, time of day, and runway used. If necessary, forecasts included in adopted master plans should be extended to ensure that the compatibility plan reflects the anticipated growth of airport activity for at least a 20-year period.

Note that any ALUC-generated extension of an airport's activity forecasts must be based upon the approved development plan for the airport; the ALUC does not have the authority to modify the airport development plan or propose changes in operation of the airport.

- **Planning Area Boundaries** — The boundaries of the ALUC planning area around each airport must be specified in the compatibility plan. Normally the planning area boundaries are shown on an airport vicinity base map which identifies roads, water courses, section lines, and other natural and man-made features. When the boundaries do not follow geographic features, distances from the airport runways should be specified.

See Chapter 3 for a discussion of factors which determine overall planning area boundaries.

Factors which should be considered in formulating specific compatibility policies and criteria are discussed in Chapter 3.

- **Compatibility Policies and Criteria** – The central components of a compatibility plan are the compatibility policies and criteria. Most plans contain a combination of policy statements and criteria tables. *It is important that policies and criteria be stated as clearly, precisely, and completely as possible because they will serve as the basis for future project reviews and compatibility determinations.* Also, for ease of use, it is desirable to gather compatibility policies and criteria into a single portion of the plan rather than have them scattered throughout the document. Compatibility policies are usually organized into groups according to the respective types of compatibility concerns which the policies address.
  - *Noise* – The California Airport Noise Standards (adopted as required by Public Utilities Code Section 21669), together with the projected Community Noise Equivalent Level (CNEL) contours of individual airports, provide the basis for most noise compatibility criteria.
  - *Safety* – The FAA-defined runway protection zones at the ends of each runway are the most critical areas, but safety concerns also extend to other portions of an airport's environs.
  - *Airspace Protection* – From a land use compatibility standpoint, airspace protection primarily entails setting limits on the heights of objects around airports. The principal criteria for protection of airport airspace are set forth in Part 77 of the Federal Aviation Regulations, *Objects Affecting Navigable Airspace*.
  - *Overflight* – This category of policies, frequently omitted from compatibility plans, is intended to address public concerns over aircraft overflights in areas beyond the defined noise contours and safety zone boundaries.

See Chapter 4 for further discussion of this topic.

- **Types of Actions Reviewed** – The types of local planning actions which the ALUC is authorized to review should be listed in the compatibility plan. A distinction should be made between the actions for which review is required in accordance with state law and ones which the commission wishes to review with the voluntary agreement of the local agency involved.

A discussion of the procedural factors to be considered during a project review is included in Chapter 4.

- **Procedural Policies** – Often overlooked in compatibility plans is a statement of the process which an ALUC will use in carrying out its mandated review of local actions. *Procedural policies should be included in each commission's compatibility plan (or, alternatively, in the commission's rules and regulations).* Procedural policies should address:
  - *Project Information* – What information about a project or action does the ALUC need to receive in order to perform an adequate review? A listing of the required information should be set forth in the compatibility plan.

- *Timing of Review* — What is the appropriate timing of ALUC review relative to other local actions on a project?
- *ALUC Action Choices* — What choices of action does the law permit an ALUC to make when responding to a project submitted for review? This response is primarily limited to a finding of *consistency* or *inconsistency* with the compatibility plan. The options should be made clear in the plan's procedural policies.
- *ALUC Decisions* — ALUCs should adopt a policy indicating that they reserve the right to decide whether a proposed local action meets the compatibility criteria set forth in a compatibility plan.

Optional Elements

Inclusion of these elements in an ALUC compatibility plan is regarded as optional.

Many compatibility plans contain other elements which, although not essential to the function of ALUCs, may be helpful to the commission members and their staff when carrying out their responsibilities.

- **Land Use Information** — Maps showing land uses in the airport vicinity can be useful during the compatibility plan adoption process and the review of local general plans. A simple map or an air photo can show the limits of existing development. Simplifying and combining the general plan land use maps of each of the jurisdictions around an airport can give a valuable overview of future land use development potential. The drawback to including this mapping in the compatibility plan document is that, to remain useful, it may need regular updating.

- **Discussion of Compatibility Issues** — A discussion of the rationale behind the compatibility policies and criteria can be an informative addition to a compatibility plan. Including this supporting documentation in a separate part of the plan, or even in a separate document, allows the policy section to remain concise and to focus purely on the substance of the policies. Part II of this *Handbook* contains this type of discussion and can serve in lieu of or as a source for documentation which individual ALUCs might prepare.

An extended discussion of implementation issues is contained in Chapters 4 and 5 of this document.

- **Implementation Issues** — Issues involving implementation of a compatibility plan are sometimes examined in a section of the plan or in a separate document. Two particular implementation issues are:
  - *Local General Plan Consistency Review* — During the compatibility plan adoption process, an understanding of consistencies and conflicts between the draft plan and local general plans is often valuable. Once the local governments have modified their general and any applicable specific plans, this information serves no further purpose.

- *Local Government Action Choices* — For a local general plan to be consistent with an ALUC compatibility plan, it does not necessarily have to be identical. A local government can achieve consistency between its plan and the compatibility plan in various ways. To assist the local government in this process, a discussion of the action choices is sometimes included in ALUC compatibility plans.

- **Supporting Materials** — For quick reference, the inclusion of the following items as appendices to a compatibility plan is often of value:
  - *ALUC Statutes in State Aeronautics Act* — Because changes to the law have occurred nearly every year, this material needs to be kept current. The date of the latest revisions included in the copy should be clearly shown.
  - *Federal Aviation Regulations Part 77* — The specific language of the FAA's regulations regarding protection of airspace around airports is occasionally important during review of a proposed project. Also important is the portion of this regulation which requires that the FAA be notified prior to construction of tall objects.
  - *Sample Easement and Deed Notices* — A requirement for dedication of an easement or recording of a deed notice is commonly found among the compatibility criteria for new development near an airport. Placing sample versions of such documents in a compatibility plan appendix should be considered.

ADOPTION PROCESS

Involvement of Local Agencies

ALUC adoption of a compatibility plan begins a 180-day time period within which the county and affected cities must either amend their general plans and applicable specific plans to be consistent with the ALUC's compatibility plan or make appropriate findings and override the ALUC. This process is addressed in Chapter 4.

With one exception, there is no legal requirement that ALUCs involve local agencies in the process of preparing and adopting a compatibility plan. The single requirement, as mentioned earlier, is for consultation with the affected local jurisdictions prior to establishment of planning boundaries (Section 21675(c)).

Nevertheless, the practical matter is that compatibility plans are generally much more effective if they are developed with close attention to local agency concerns. ALUC adoption of compatibility policies and criteria which will routinely result in local agency override actions accomplishes little to promote airport land use compatibility objectives.

Environmental Document Requirements

No conclusions are offered here as to which CEQA form is the most legitimate. ALUCs are advised to consult with their respective legal counsels when this question is a significant issue.

The requirements for preparation of California Environmental Quality Act (CEQA) documentation when adopting or amending a compatibility plan are not mentioned in the ALUC statutes. Three options are possible and all have been utilized at various times by different ALUCs.

- **Exemption** — Some ALUCs have regarded adoption of a compatibility plan to be statutorily exempt from CEQA regulations. ALUCs are not the ultimate authority regarding any local land use proposal — their actions on land use development are always subject to being overridden by the local jurisdiction. Therefore, these ALUCs reason that, because of this lack of implementation or final approval authority, adoption of a compatibility plan is not a *project* within the meaning of CEQA.

- **Negative Declaration** — Preparation of an Initial Study and a Negative Declaration is the CEQA route most commonly taken by ALUCs when adopting a compatibility plan. In reviewing the environmental impacts of a compatibility plan, most impact categories clearly do not apply. Those that have some application — noise, safety, and land use, in particular — are usually examined rather briefly. The rationale for concluding that no significant impacts would result is often based upon the same factors used with respect to the exemption position, namely that ALUCs have no land use implementation or final approval powers.

- **Environmental Impact Report** — Most of the compatibility plans for which EIRs are written are ones prepared in conjunction with a local specific plan or an airport master plan for which an EIR is necessary. Occasionally an ALUC will prepare an EIR simply as means of addressing the concerns of local agencies and landowners over the implications of the compatibility plan.

Public Hearing Requirements

The aeronautics law does not specifically require that an ALUC hold a public hearing in order to adopt a compatibility plan. A hearing is required only with respect to establishment of an airport planning area boundary. Other laws applicable to ALUCs also do not require the holding of a public hearing. The Brown Act requires only that ALUC meetings be open to the public, not that public input be received. Furthermore, nothing in the California Environmental Quality Act mandates a public hearing; public input can be limited to correspondence only. From a practical perspective, however, ALUCs are well advised to solicit public and local agency input before adopting a compatibility plan, even if a formal public hearing process is not utilized.

Plan Amendments

State law (Section 21675(a)) limits amendment of a compatibility plan to no more than once per calendar year. For compatibility plans which pertain to more than one airport, this limitation has generally been interpreted as allowing separate amendments for the portion dealing with each individual airport. Any policies applicable to all airports in the ALUC's jurisdiction can be amended only once during a year.

This same section of the law also states that a compatibility plan "shall be reviewed as often as necessary in order to accomplish its purpose." A periodic reexamination of the entire plan is strongly encouraged as a means of keeping it up to date with changes in state laws, local land uses, airport development and activity, and current concepts for achieving noise and safety compatibility. Depending upon the rapidity with which these changes occur, a thorough review is appropriate every five to ten years.

The review and amendment process should follow essentially the same steps as noted above for the original adoption process. Certain steps generally can be simplified if the changes to the plan are relatively minor. Coordination with local jurisdictions is nevertheless still important, particularly if the changes affect the consistency with local general plans.

As with the initial adoption of the compatibility plan, the local jurisdiction again has 180 days within which to amend its plans to be consistent with the compatibility plan or to approve findings and override the ALUC.

Chapter 3

Formulating Airport Land Use Compatibility Policies

3

Formulating Airport Land Use Compatibility Policies

OVERVIEW

Although various policy examples are noted herein, *it is not the intent of this chapter to require ALUCs to adopt specific compatibility criteria or other policies* for all airports or even general classes of airports. The intent is to provide general guidance and recommendations.

Compatibility policies, including both criteria and maps, are the central component of any compatibility plan. The purpose of this chapter is to examine factors which should be considered in the development of airport compatibility policies.

The individual categories of airport impacts which typically are the concerns of airport land use commissions are discussed in the immediately following section of this chapter. The concepts outlined form the basis for development of compatibility policies. This chapter's third section focuses upon alternative means of formatting compatibility criteria tables and maps. Finally, several issues are addressed which deal with limits on the degree of restrictiveness that an airport land use commission can realistically impose on airport area land uses.

TYPES OF COMPATIBILITY CONCERNS

See Part II of the *Handbook* for discussions of noise and safety concepts, their characteristics, and the relationship of these characteristics to land use compatibility and planning.

As indicated in the preceding chapters, the airport land use compatibility concerns of ALUCs fall under two broad headings identified in state law: noise and safety. However, for the purposes of formulating airport land use compatibility policies and criteria, further dividing these basic concerns into four functional categories is more practical. Traditionally, these categories are:

- *Noise* — As defined by measurable levels of noise from aircraft operations near an airport.
- *Safety* — From the perspective of minimizing the risks of aircraft accidents beyond the runway environment.
- *Airspace Protection* — Accomplished by limits on the height of structures and other objects in the airport vicinity and restrictions on other uses which potentially pose hazards to flight.

- *Overflight* — The loosely defined impacts of routine aircraft flight over a community.

The formulation of airport land use compatibility policies and associated criteria in each of these four categories is discussed on the following pages. The emphasis, however, is on ways of *categorizing* and *organizing* the policies rather than on the *concepts* behind them. The latter is the major topic of Part II.

For each compatibility category, four features are outlined below:

- *Compatibility Objective* — The objective to be sought by establishment and implementation of the compatibility policies;
- *Measurement* — The scale on which attainment of the objectives can be measured;
- *Compatibility Strategies* — The types of strategies which, when formulated as compatibility policies, can be used to accomplish the objectives; and
- *Basis for Setting Criteria* — The basis upon which the respective compatibility criteria have traditionally been established.

A summary of basic criteria appropriate for each of the four compatibility categories is presented in Table 3A. These criteria follow from the discussion in this section and are further supported by the material included in Part II. Two points should be noted about the criteria shown in Table 3A:

- One point is that the criteria are written in general, qualitative (not precise, quantitative) terms. In effect, they are a criteria checklist rather than actual, airport-specific criteria. For use in a compatibility plan, the criteria need to be more fully defined to suit local circumstances. Also, the boundaries of the zones within which each criterion applies must be delineated with respect to the conditions at a specific airport.
- Secondly, it should be emphasized that, even in their general form, these criteria are only suggestions for consideration by individual ALUCs. They are not intended to be treated as state-mandated standards.

Noise

Noise is one of the most basic airport land use compatibility concerns. Moreover, at major airline and many busy general aviation airports it is usually the most geographically extensive form of airport impact.

Compatibility Concern	Compatibility Zone Delineation	Suggested Compatibility Criteria
Noise	• Calculated noise contours;[1] or • Generalized area encompassing individual contours.	• No residential within 65 dB CNEL contour. • Encourage use of 60 dB CNEL as maximum for residential land uses in quiet communities (or even 55 dB at rural airports).
Safety	• Up to 6 zones based upon relative risk of aircraft accidents in each area.[2] • Take into account typical flight tracks and areas overflown by aircraft at low altitude. • Consider instrument arrival and departure routes.	• Runway Protection Zones: – No structures. – No assemblages of people. – Encourage airport to own the property. • Inner Safety Zones: – Preferably no residential uses or, at most, very low density. – Limit other uses to ones which attract relatively few people and leave substantial areas without structures. – Prohibit bulk storage of flammable or hazardous materials. – Prohibit schools, hospitals, nursing homes. – Maintain as much open land as possible by clustering of development. • Inner Turning Zones: – Residential uses only at very low density. – Restrictions on other uses similar to Inner Safety Zone. • Outer Safety Zones: – No urban density residential subdivisions. – Other uses limited to ones with moderate concentrations of people. – Avoid schools, hospitals, nursing homes. – Maintain as much open land as possible by clustering of development. • Sideline Zones (Areas Adjacent to Runways): – All common aviation-related uses acceptable. – Limit non-aviation uses, on- or off-airport, to low-intensity activities. – Prohibit schools, hospitals, nursing homes. • Traffic Pattern Zone: – Avoid high-density residential unless clustered to leave open areas in between. – Avoid activities with very high concentrations of people. – Avoid schools, hospitals, nursing homes.
Airspace Protection	• Zones defined by Part 77 of Federal Aviation Regulations.	• Limit heights of objects in accordance with Part 77 criteria. • Avoid other hazards to flight anywhere in airport vicinity.
Overflight	• Easiest to define in terms of Part 77 horizontal zone, modified as necessary to exclude areas not routinely overflown by aircraft flying to and from airport.	• Establish some form of buyer awareness program.

[1] See Chapters 7 and 8 for a discussion of factors to be considered in calculation of noise contours.

[2] See Chapter 9 (specifically Figure 9G) for suggestions regarding safety zone shapes and dimensions.

NOTE: *These criteria should be treated as general suggestions for consideration by individual ALUCs, not as state-mandated standards. Economic and technical feasibility may need to be taken into account when setting criteria for individual airports.*

Source: Hodges & Shutt (December 1993)

Table 3A

Summary of Suggested Compatibility Criteria

- **Compatibility Objective** — The clear objective of noise compatibility criteria is to minimize the number of people exposed to frequent and/or high levels of airport noise.

See Chapter 6 for an extended review of noise characteristics and effects.

- **Measurement** — Noise generated by the operation of aircraft to, from, and around an airport can be measured both in terms of the overall average or cumulative noise levels of all aircraft operations and the noise of individual aircraft takeoffs or landings.

  - *Cumulative Noise Levels* — The most widely applied measures of airport noise are cumulative noise levels such as those described by the Community Noise Equivalent Level (CNEL) metric or, other than in California, by the Day-Night Average Sound Level (DNL or L_{dn}) metric. Both of these noise metrics provide a single measure of the average sound level in decibels (db) to which any point near an airport is exposed. To reflect supposedly greater community sensitivity to nighttime and (for CNEL only) evening noise, events during these periods are counted as being louder than actually measured. Cumulative noise levels are usually illustrated on airport area maps as contour lines connecting points of equal noise exposure. Mapped noise contours primarily show areas of significant noise exposures — ones affected by high concentrations of aircraft takeoffs and landings.

    The calculation of cumulative noise levels depends upon the number, type and time of day of aircraft operations, the location of flight tracks, and other data described in Chapter 6. For airports with air traffic control towers, some of these inputs can be derived from recorded data. However, at most airports, the individual variables must be estimated. The important point to be made here is that, despite their computer-generated origin, the location of noise contours entails an inherent degree of imprecision. The level of accuracy has generally been found to be within ±3 dB.

  - *Single-Event Noise Levels* — For various reasons discussed in Chapter 6, there is on-going nationwide debate regarding the appropriateness of single-event noise level criteria as a supplement or replacement for cumulative noise level metrics. The argument chiefly made is that cumulative noise level metrics do not adequately identify some aspects of noise exposure effects, particularly within the context of assessing the environmental impacts of airport improvement projects. The perspective of this *Handbook* is that cumulative noise level metrics remain an essential tool for the purposes of airport land use compatibility planning. Other characteristics of noise, whether measured on a decibel scale or evaluated in a more qualitative manner, may nevertheless also need to be considered as discussed below with respect to overflight issues.

- **Compatibility Strategies** — The basic strategy for achieving noise compatibility in an airport vicinity is to limit the development of land uses which are particularly sensitive to noise. The most acceptable land uses are ones which either involve few people (especially people engaged in outdoor activities), or generate significant noise levels themselves (such as other transportation facilities or industrial uses).

- **Basis for Setting Criteria** — Compatibility criteria related to cumulative noise levels are well-established in federal and state laws and regulations. The basic criterion sets a CNEL or DNL of 65 dB as the maximum noise level normally compatible with residential land uses. Criteria for other land uses are established in a manner consistent with this starting point. The overall scale should be adjusted to reflect ambient sound levels and the community's previous exposure to noise.

Safety

Compared to noise, safety is in many respects a more difficult concern to address in airport land use compatibility policies. A major reason for this difference is that safety policies address uncertain events which *may occur* with *occasional* aircraft operations, whereas noise policies deal with known, more or less predictable events which *do occur* with *every* aircraft operation. Because aircraft accidents happen infrequently and the time, place, and consequences of their occurrence cannot be predicted, the concept of *risk* is central to the assessment of safety compatibility. From the standpoint of land use planning, two variables determine the degree of risk posed by potential aircraft accidents:

- *Accident Frequency* — Where and when do aircraft accidents occur in the vicinity of an airport?

- *Accident Severity* — What land use characteristics contribute to the consequences of an accident when one occurs?

- **Compatibility Objective** — The overall objective of safety compatibility criteria can be simply stated as being to minimize the risks associated with potential aircraft accidents. There are two components to this objective, however:

  - *Safety on the Ground* — The most fundamental safety compatibility component is to provide for the safety of people and property on the ground in the event of an aircraft accident near an airport.

  - *Safety for Aircraft Occupants* — The other important component is to enhance the chances of survival of the occupants of an aircraft involved in an accident which takes place beyond the immediate runway environment.

- **Measurement** — Measurement of safety is usually thought of in terms of the frequency component of risk assessment: what is the potential for an accident to occur? As mentioned above, there are both *where* and *when* variables to the frequency equation:

- *Spatial Element* — The spatial element describes *where* aircraft accidents can be expected to occur. Of all the accidents which occur in the vicinity of airports, what percentage occur in any given location?
- *Time Element* — The time element adds a *when* variable to the assessment of accident frequency. In any given location around a particular airport, what is the chance that an accident will occur in a specified period of time?

Except with respect to airspace protection, ALUCs have virtually no powers to implement actions which can reduce the *frequency* of aircraft accidents. An understanding of the *spatial* element of accident frequency — as examined in Chapter 8 — is nevertheless essential to ALUC development of effective measures to limit the potential *severity* of accidents.

- **Compatibility Strategies** — Safety compatibility strategies focus on the *severity* component of risk assessment. Basically, the question is: what land use planning measures can be taken to reduce the severity of an aircraft accident if one occurs in a particular location near an airport? Although there is a significant overlap, specific strategies must consider both components of the safety compatibility objective: protecting people and property on the ground; and enhancing safety for aircraft occupants. In both cases, the primary strategy is to limit the intensity of use in locations most susceptible to an off-airport aircraft accident. This is accomplished by:
  - *Density Limitations* — Establishment of criteria limiting the maximum number of dwellings or people in areas close to the airport is the most direct method of reducing the potential severity of an aircraft accident.
  - *Open Space Requirements* — Creation of requirements for open space near an airport addresses the objective of enhancing safety for the occupants of an aircraft forced to make an emergency landing away from a runway.
  - *Special Functions Restrictions* — Certain critical types of land uses — particularly schools, hospitals, and other uses in which the mobility of occupants is effectively limited — should be avoided near the ends of runways regardless of the number of people involved. Aboveground storage of large quantities of highly flammable or hazardous materials also should be avoided near airports.

Under many circumstances, one means of implementing both the density limitations and open space requirements strategies is through clustering of development. This concept is discussed in Chapter 9.

- **Basis for Setting Criteria** — Setting safety compatibility criteria presents the fundamental question of what is safe. Expressed in another way: what is an *acceptable risk*? In one respect, it may seem ideal to reduce risks to a minimum by prohibiting most types of land use development from areas near airports. However, as addressed in the final section of this chapter, there are usually costs associated with such high degrees of restrictiveness. In practice, safety criteria are set on a progressive scale with the greatest restrictions established in locations with the greatest potential for aircraft accidents.

- *Established Guidance* – As noted in Chapter 9, little established guidance is available to ALUCs regarding how restrictive to make safety criteria for various parts of an airport's environs. Unlike the case with noise, there are no formal federal or state laws or regulations which set safety criteria for airport area land uses except within runway protection zones (and with regard to airspace obstructions as described separately in the next section). Federal Aviation Administration safety criteria primarily are focused on the runway and its immediate environment. Runway protection zones were originally established mostly for the purpose of protecting the occupants of aircraft which overrun or land short of a runway, but are now defined by the FAA as intended to enhance the protection of people and property on the ground.
- *New Research* – To provide a better foundation for establishment of safety criteria in other portions of the airport environs, extensive research into the distribution of accident locations was conducted as an initial step in preparation of this *Handbook*. The results are outlined in Chapter 8. However, even with this new data on which to base safety compatibility decisions, the question is still ultimately one of what is acceptable to the local community.

Airspace Protection

Relatively few aircraft accidents are caused by land use conditions which are hazards to flight. The potential exists, however, and protecting against it is essential to airport land use safety compatibility.

Protection of airport airspace is one of the few actions which ALUCs can take to help reduce the *frequency* of aircraft accidents.

- **Compatibility Objective** – Because airspace protection is in effect a safety factor, its objective can likewise be thought of in terms of risk. Specifically, the objective is avoid development of land use conditions which, by posing hazards to flight, can increase the risk of an accident occurring. The particular hazards of concern are:
  - Airspace obstructions; and
  - Land use characteristics which pose other potential hazards to flight by attracting birds or creating visual or electronic interference with air navigation.
- **Measurement** – The measurement of requirements for airspace protection around an airport is a function of several variables including: the dimensions and layout of the runway system; the type of operating procedures established for the airport; and, indirectly, the performance capabilities of aircraft operated at the airport.

Excerpts from Part 77 are included in Appendix E.

- *Airspace Obstructions* — Whether a particular object constitutes an airspace obstruction depends upon the height of the object and its proximity to the airport. The acceptable height of objects near an airport is determined by application of standards set forth in Part 77 of the Federal Aviation Regulations. These regulations establish a three-dimensional space in the air above an airport. Any object which penetrates this volume of airspace is considered an obstruction and may affect the aeronautical use of the airspace.

- *Other Hazards to Flight* — The significance of other potential hazards to flight is primarily measured simply in terms of their distance from the airport and/or its normal traffic patterns.

- **Compatibility Strategies** — Compatibility strategies for the protection of airport airspace are relatively simple and are related directly to the individual types of hazards:

  - *Airspace Obstructions* — Buildings, antennas, other types of structures, and trees should be limited in height so as not to pose a potential hazard to flight.

  - *Other Hazards to Flight* — Land uses which may create other types of hazards to flight near an airport should be avoided or modified so as not to include the offending characteristic.

- **Basis for Setting Criteria** — The criteria for determining airspace obstructions and other hazards to flight have been long-established in Federal Aviation Administration regulations and guidelines. Also, the state of California utilizes the same airspace obstruction criteria in the regulations set forth in state aeronautics law.

Overflight

As the term is applied herein, an *overflight* means any distinctly visible and audible passage of an aircraft, not necessarily one which is directly overhead.

ALUCs are encouraged to consider aircraft overflight concerns when developing airport compatibility plans.

Experience at many airports has shown that noise-related impacts do not stop at the boundary of the outermost mapped CNEL or DNL contour. Many people are sensitive to the frequent presence of aircraft overhead even at noise levels lower than typically measured by cumulative noise level contours. A fear factor also contributes to this sensitivity. This category of compatibility concern is not one for which many ALUCs have adopted criteria or policies. Nevertheless, it is a concern which is increasingly being expressed — often in the form of *annoyance* — by people in communities around airports.

- **Compatibility Objective** — The compatibility objective associated with overflight impacts is not easily expressed in land use planning terms. It can perhaps be stated as being to help people with above-average sensitivity to aircraft overflights — people who are highly *annoyed* by overflights — to avoid living in locations where frequent overflights occur.

- **Measurement** — Determining where to draw the line around areas of significant aircraft overflight exposure can be difficult if an attempt is made to define the area in terms of measured sound levels. Although the sound levels are detectible and therefore measurable, the highly subjective individual reactions to overflights makes the value of measurement on a decibel scale questionable.

  Empirical studies have documented that the absolute number of aircraft overflights of a residential area is a factor in the perception of annoyance. However, for the purposes of airport land use compatibility planning, it is better to simplify this measurement. The potential existence of overflight concerns can reasonably be defined by the location of standard airport traffic patterns and other flight tracks routinely used by aircraft in the airport vicinity, especially at or below traffic pattern altitudes.

Descriptions and discussion of these buyer awareness measures are included in Chapter 5.

- **Compatibility Strategies** — The ideal land use compatibility strategy with respect to overflight annoyance is to avoid development of residential areas in the affected locations. To the extent that this approach is not practical, the alternative is make people better aware of the airport's proximity before they move to the area. This can be accomplished through buyer awareness measures such as:

  - Dedication of avigation or overflight easements;
  - Recorded deed notices; and/or
  - Real estate disclosure statements.

- **Basis for Setting Criteria** — Overflight criteria are comparatively new to airport land use compatibility planning. The basis for setting criteria is primarily the experience of individual airports and airport land use commissions.

COMPATIBILITY CRITERIA TABLES AND MAPS

Identification of land use compatibility strategies such as those outlined in the preceding section is only one part of the process of developing compatibility policies. The other piece of the puzzle is to relate these strategies to the airport environs based upon categories of land uses and/or geographically. This is commonly done by means of compatibility criteria tables and compatibility zone maps.

- Compatibility criteria tables indicate the relationships between the magnitude of airport impacts and the categories of land uses.
- Compatibility maps show where the various criteria geographically apply within the airport vicinity.

Compatibility Criteria Table and Map Formats

For noise, safety, and overflight compatibility concerns, the compatibility of a given land use is a function of both the magnitude of the airport impacts and the characteristics of the particular land use category. Airspace protection is the one type of compatibility concern which is largely independent of land use classification. These relationships are ordinarily presented in the form of a compatibility criteria table or matrix. The magnitude of airport impacts is shown on accompanying compatibility maps.

Three basically distinct table and map formats have evolved among the compatibility plans adopted by ALUCs in California. As with many other facets of compatibility planning, there are advantages and disadvantages to each choice with none being clearly the best.

Separate Criteria Tables and Maps

See Appendix C for examples of these formats. The first page of the appendix lists the specific exhibits in which the criteria tables and maps treat noise and safety separately.

The traditional approach to compatibility criteria tables and maps is to have separate sets for each type of impact. For noise, the table indicates whether each land use classification is or is not acceptable within various ranges of noise exposure as measured on the CNEL scale. For safety, the relationship is between each land use category and the accident potential of various locations in the airport vicinity.

- **Advantages** — The chief advantage to this approach is that the relationships between the noise and safety concerns and the associated criteria are relatively obvious. For example, residences should not be exposed to noise levels above a CNEL of 65 dB and schools and shopping centers should not be situated in a runway protection zone.

- **Disadvantages** — The disadvantages involve ease of use and occasional confusion in its application. Although technically sound, the use of separate criteria and maps can be more complicated and require greater understanding of airport land use compatibility concepts. For any given land use classification or individual development proposal to be evaluated, it must checked against multiple sets of criteria tables and maps — noise, safety, and overflight impacts — as well as a map of protected airspace. The confusion sometimes arises because of the lack of coordination between the impact assessments. For a given location, one type of land use may be acceptable with respect to noise, but not for safety; another use may be just the opposite; and, taken together, most forms of urban land use development may sometimes appear to be ruled out.

  Another disadvantage is the tendency to rigidly apply the delineated zone boundaries, especially for noise, to the evaluation of a particular land use project or action. Although often advantageous from the standpoint of planning practice, rigid application of the boundaries implies a degree of precision which is not existing in the measurement of the airport impacts.

Combined Criteria Table and Map

See Appendix C for examples of combined compatibility criteria tables (Exhibits 5, 9, and 12) and maps.

The second approach attempts to simplify compatibility assessments by condensing the various factors down to a single set of criteria presented in one table and one map for each airport. The map defines a small number of discrete zones — preferably no more than five or six — which represent locations with similar *combinations* of noise, safety hazard, and overflight exposure.

- **Advantages** — One advantage to the combined approach is that it allows most land uses to be evaluated with quick reference to a single table and map. More significantly, though, is that it allows more flexibility in the mapping of compatibility zones. As discussed later in this chapter, generic boundaries can be drawn for a limited number of airport classes. These boundaries can then be applied to all similar airports in the ALUC's jurisdiction and adjusted as necessary to reflect atypical airport operational characteristics, local geographic boundaries, and established land uses.

- **Disadvantages** — The major disadvantage to combining compatibility criteria into a single table and map is that the basis for location of the zone boundaries is not always clear. If more detailed assessment of a complex land use development proposal is necessary, reference to separate noise and safety compatibility tables and maps is often still required.

Detailed Land Use Map

An example of this map format is found in Appendix C, Exhibit 7B.

A final format found among some compatibility plans is a detailed land use map comparable to ones found in general plans or specific plans. This format is most likely to be utilized when the ALUC adopts a compatibility plan which is also prepared for local agency adoption as a specific plan. Depending upon the extent to which the land use categories reflect airport compatibility concerns, a detailed land use map conceivably can bypass the need for compatibility criteria tables.

- **Advantages** — Probably the most significant advantage of the detailed land use map approach to compatibility mapping is that it enables the same map to be adopted by the ALUC as a compatibility plan and by the local agency as a specific plan. Because the maps and plans (or at least the airport-related portions of them) are identical, the two are automatically consistent with each other.

- **Disadvantages** – A major disadvantage of this approach is that it entails more work to prepare than is necessary for the other formats. A detailed land use map prepared for a specific plan must take into account factors which are not of concern to the ALUC. Close cooperation between the ALUC and the city or county preparing the specific plan is necessary to assure that all essential factors are addressed. Also a potential disadvantage is that a detailed land use map of this type pertains only to a single airport and the compatibility criteria on which it is based may not correspond very closely to criteria used in compatibility plans for other airports within the ALUC's jurisdiction.

Categorization of Land Uses

The other variation in the formatting of compatibility criteria pertains to how land uses are categorized in the compatibility table or tables. There are two different approaches to the listing of land uses. Both are common among ALUC compatibility plans and, as with the overall format of the tables, each has advantages and disadvantages.

Detailed Listing Format

Examples of detailed listing of land use categories as found in different compatibility tables are included in Appendix C. Refer to the listing in the appendix for specific examples.

One approach to land use categorization is to divide the full range of land uses into specific classes. The number of classifications might be relatively few in number – residential, commercial, industrial, public facility, etc. – as commonly found on general plans or specific plans. Alternatively, a much more narrowly defined listing might be utilized. One such listing, the standard land use code system – originally developed by the U.S. Department of Housing and Urban Development and currently being updated – contains over 100 classes of land uses.

The detailed listing approach to land use categories works with either separate or combined compatibility tables and maps. It is essential if a detailed land use map approach is used.

- **Advantages** – The advantage of the detailed listing approach is that it removes most of the need for interpretation of standards as required within the performance-oriented categories. Each listed use can be denoted as either *compatible* or *incompatible* with a given level of airport impacts. This greatly simplifies the task of local planners when they must evaluate an individual development proposal either with respect to the ALUC's compatibility plan directly or the local agency's general or specific plan.

- **Disadvantages** – The major disadvantage of this method is that, unless the land use categories are defined very narrowly, the density of use (the number of people per acre) and other characteristics which affect compatibility might cover a wide range. Indicating that a particular land use is compatible with the airport could result in development of an activity which clearly exceeds the density of use considered acceptable. Oppositely, listing a land use as incompatible might preclude a development which could be a good airport neighbor. Some ALUCs resolve this problem by including a third consistency category: *conditionally compatible*. Assessment of the compatibility of an individual development proposal then usually requires returning to functionally oriented criteria as described below.

Another potential difficulty with including a detailed listing of land uses in a compatibility plan is that the selected categories may not conform to those used by the local land use jurisdictions. This is particularly likely to occur when the compatibility plan covers multiple airports and encompasses several cities and/or counties, each with its own set of land use categories.

Functional or Performance-Oriented Characteristics

This form of land use categorization is more difficult to explain than to show in an example. Three applications of this format are included in Appendix C (Exhibits 5A, 10B, and 13A).

This approach is applicable only when a combined compatibility table and map are utilized. The concept entails dividing land uses according to characteristics related to the previously described compatibility planning strategies. The number of categories needed is thus kept small. No distinctions are made among different types of land uses with similar functional or performance-oriented characteristics — for example, between an office and a retail store which attract the same number of people in buildings equivalent in size. When this method of land use categorization is used in a compatibility table, the result for most categories is not an indication of whether the land use is compatible or incompatible. Rather, the table establishes a set of criteria based upon specified performance measures which, if satisfied, will result in compatible land use.

A typical set of performance-oriented land use characteristics and their respective compatibility measures is as follows:

- **Residential Density** — For airport compatibility purposes, the chief distinguishing feature among residential land uses is the number of dwelling units per acre. To be compatible with airport activities, the number of dwelling units per acre should not exceed the criterion specified for the compatibility zone where the use would occur.

- **Non-Residential Density of Use** — The most significant factor among most other types of land use development is the number of people attracted by the use. Sometimes the established criteria distinguish between uses which take place in structures and those which are outdoor activities. With the exception of certain special uses, the nature of the activity associated with the actual land use is not highly relevant to airport land use compatibility objectives.

- **Special Uses** — The special use category includes schools, hospitals, and other similar uses for which a high degree of compatibility is typically sought. Normally, these uses are directly evaluated as prohibited or acceptable within a given compatibility zone.

- **Open Space** — Requirements for open space usable for the emergency landing of aircraft near an airport apply regardless of the overall land use classification of the property. The associated criteria indicate what percentage of the land area in each compatibility zone should be devoted to functional open space.

- **Permitted Heights** — Another land use characteristic that can be incorporated into a combined compatibility table is the height of structures which can clearly be attained without penetration of the airport airspace. However, at airports where elevations of the surrounding terrain vary substantially, inclusion of this category might be impractical because of the lack of consistent relationship between the height permitted and the location of the individual compatibility zones.

Advantages and disadvantages of this style of land use categorization include:

- **Advantages** — The principal advantage of performance-oriented categorization of land uses is that this method directly addresses factors pertinent to airport land use compatibility. Recognition is given to significant land use characteristics which might not be distinguished in a traditional listing of land uses.

- **Disadvantages** — The significant disadvantage of performance-based land use categories is that assessing the compatibility of a particular land use designation or individual development proposal requires interpretation of the associated criteria. If, for example, data regarding the density of use is not available, then compatibility evaluation will require reliance on information sources (building and fire code standards, for example) which may not accurately reflect the aviation-related concerns. The results may not always be consistent with previous determinations.

Preparing Compatibility Maps

With any of the three compatibility table and map formats, several important factors should be considered when preparing the compatibility maps for a particular airport.

Determining Compatibility Zone Boundaries

Delineating appropriate compatibility zone boundaries is a much easier process when individual maps are prepared for each compatibility concern than it is when a combined compatibility map or a detailed land use map is developed.

Several examples of separate compatibility maps are included in Appendix C. Refer to the appendix index list.

- **Separate Compatibility Maps** — With this format, each map directly reflects the associated airport impacts:
  - *Noise* — Community Noise Equivalent Level contours directly from the computer output or with minor graphical clean-up can be utilized.
  - *Safety* — ALUCs which use separate mapping of each compatibility concern typically establish three to six safety zones reflecting assumed accident potential. The distinct zones might include: the runway protection zone; an approach zone (perhaps divided into two segments); a traffic pattern overflight zone; and sometimes a zone encompassing areas adjacent to the runway.
  - *Airspace Protection* — The height-limit component of airspace protection can be mapped from the Federal Aviation Regulations, Part 77, airspace plan prepared for the airport. Zones related to bird strike hazards and visual and electronic interference concerns are seldom mapped.
  - *Overflight* — Areas where overflight compatibility criteria apply are usually shown on noise or safety compatibility maps rather than separately.

Accident location data gathered for the preparation of this *Handbook* can help to refine the boundaries of safety compatibility zones for individual airports. See the discussion in Chapter 9.

Two examples of a typical civilian airport airspace plan are illustrated in Appendix C (Exhibit 1A and 1B). A military airport airspace plan is shown in Exhibit 8C.

Exhibits 5B, 9B, and 12B in Appendix C are examples of combined criteria maps.

- **Combined Criteria Maps** — For most airports, preparation of a map of combined compatibility zones for an airport often begins with application of a standard compatibility map template which most closely reflects the airport's characteristics. The templates are developed by classifying airports according to type of procedural approach (visual, nonprecision, or instrument) and various ranges of aircraft operations. Once an appropriate template has been selected, modifications must be made to reflect the runway configuration and lengths, traffic pattern locations, and any other airport-specific conditions. Adjustments for geographic features, existing land use development, and other local land use characteristics also may be appropriate.

  Even when a combined map is used for noise, safety, and overflight compatibility evaluation, a separate map is usually prepared to allow precise assessment of airspace protection requirements.

- **Detailed Land Use Map** — As with the combined criteria map format, preparation of a detailed land use map requires that the factors affecting land use choices be individually considered and mapped, An example of a detailed land use map is shown in Appendix C (Exhibit 7B).

then combined into a single map using an overlay process. The difference from a combined compatibility criteria map is that the detailed land use map must also take into account non-aviation determinants of land use designations. As indicated in the preceding discussion of land use categories, the designations used in a detailed land use compatibility map should divide the land use types into a sufficient number of categories to enable various degrees of airport compatibility concerns to be recognized. For example, commercial uses should be distinguished as low intensity (few people per acre) versus high intensity (many people per acre).

Relationship of Compatibility Zones to Overall Planning Area

It is not unusual for an ALUC to establish an airport planning or project referral area boundary (in accordance with Section 21675.1(b) of the state law) prior to adoption of a compatibility plan for the airport. Typically, this planning area boundary is based upon the airport's Part 77 airspace surfaces or the two-miles-from-the-airport-property-line criterion indicated in the statutes.

A reassessment of this boundary should be done as part of the preparation of a compatibility plan. Once the areas of concern for noise, safety, airspace protection, and overflight have been identified, the combination of these areas serves to define the planning area boundary. Depending upon the character of the airport, this area may be larger or smaller than the basic two-mile radius.

An alternative to stretching the airport planning area boundary simply to encompass the outermost limits of the Part 77 airspace surfaces is to require that any proposed construction more than 200 feet in height be submitted to the ALUC for review regardless of where in the county the object would be located. Proposed construction of this height also must referred to the FAA for review in accordance with Part 77 regulations.

- **Major Airline Airports** — For airports with high volumes of airline aircraft, significant noise impacts may extend several miles from the runways and be the key determinant of the size of airport planning area. Airspace protection for a precision instrument approach runway corridor can expand the boundary even further, especially if rising terrain makes height limits an important factor in this area. (The FAR Part 77 approach surface for a precision instrument runway reaches over 50,000 feet from the runway end, but the height limit at this distance is 1,200 feet above the runway end elevation.)

- **General Aviation Airports** — The driving force behind the size of the planning area for a general aviation airport varies depending mostly upon the volume of aircraft operations and the type of runway approaches. Except at moderately busy facilities (ones with at least 100,000 annual aircraft operations), safety, airspace, and overflight concerns likely will dominate in geographic extent over the size of noise exposure contours. Even at busy general aviation airports, the planning area usually will extend no more than two miles from the airport runways. For small, low-activity facilities, a radius of about one mile is common. A further reduction in the planning area sometimes may be appropriate for airports where the traffic pattern exists only on one side of the runway and the other side is largely already developed.

After compatibility criteria are defined and specific compatibility zones are delineated – whether for separate or combined criteria and maps – a gap sometimes occurs between the outermost zone and the planning/referral area boundary. In effect, this situation may result in some local planning actions or projects being referred to the ALUC for review even when any land use would be consistent with the compatibility plan. If there are no compatibility restrictions or other conditions applicable within a portion of the planning area, the commission should redraw the planning area boundary to reduce its size.

Base Map Alternatives

An important step in the mapping of an airport's compatibility zones is selection of an appropriate base map. Common alternatives include:

- **Topographic Maps** – Topographic maps prepared by the U.S. Geological Service (USGS) are available for all areas of California. Because these maps show ground elevations, they are particularly useful for airspace protection plan mapping. However, topographic maps do not show enough detail to facilitate finding particular locations within urban areas and they are often outdated as well.

- **Parcel Maps** – When available, composite parcel maps of a community (as opposed to the more detailed assessor's parcel maps of small areas) are ideal for separate or combined noise and safety compatibility mapping as well as for a detailed land use map. Occasional updating of the map may be necessary to show major new streets and subdivisions.

- **Land Use or Zoning Maps** – If sufficiently detailed, the same base maps as used for local land use or zoning purposes offer another alternative.

- **Geographic Information System (GIS) Mapping** – These computer-based mapping and data systems vary greatly in their level of detail, accuracy and currency. Street systems are typically shown, but parcel lines are less commonly depicted. Topographic information is rarely mapped. Where a GIS is used in land use decision making, it is valuable to have the ALUC maps integrated into the system. Use of GIS mapping for compatibility planning purposes is likely to become more widespread in the future as more counties and cities apply this technology to other local planning functions.

LIMITS ON LAND USE RESTRICTIVENESS

Determining Limits of Existing Development

This limitation on ALUC authority is not applicable when *redevelopment* or land use conversion is proposed. The fact that the *land area* associated with the project is already occupied by existing development — either compatible or incompatible with the airport — becomes irrelevant when that land use will be replaced by a new development or use.

The authority of ALUCs to conduct compatibility planning for areas around public airports "to the extent that these areas are not already devoted to incompatible uses" is generally accepted to mean that the commissions have no authority over areas of existing development. This suggests that it may be useful for ALUC compatibility plans to map the boundaries of areas considered to be predominantly developed.

An aerial photograph of the airport environs is an ideal tool for this purpose. It shows the extent of development on a broad scale without providing largely unnecessary detail regarding the development status of individual small parcels.

Delineation of the boundaries of existing development is particularly desirable if the ALUC's compatibility plan includes policies regarding infill and reconstruction.

Infill

By definition, *infill* areas are locations where development does not already exist. The areas thus are subject to ALUC review authority. The chief issue with regard to infill is whether it is realistic for ALUCs to attempt to prevent development of a small area surrounded by similar development even when that development is incompatible with airport activities. ALUCs clearly can determine such infill uses to be inconsistent with their adopted compatibility plan. From a practical standpoint, however, such determinations are often overridden by the local government agency.

As an alternative, ALUCs should consider establishment of policies which indicate where and under what circumstances infill can be found consistent with the compatibility plan.

- *Infill Locations* — In locations where substantial airport impacts occur — especially locations within the 65 dB CNEL contour or a runway protection zone — any incompatible development is considered undesirable. However, in more distant locations where the impacts are less, infill of otherwise incompatible development might be deemed acceptable.

- *Infill Conditions* — For infill to be permitted, specific conditions should be met to assure that a substantial increase in the overall compatibility status of the airport does not occur. For example:

- The infill area should be bounded by uses similar to those proposed.
- The proposed development should not extend the perimeter of the area already developed with incompatible uses.
- Increases in the intensity and/or incompatibility of use through use permits, density transfers or other strategies should not be permitted.
- Other applicable development conditions (such as easement dedication requirements and special structural noise level attenuation criteria) must be met.

Reconstruction

Reconstruction of existing incompatible land uses destroyed by fire or other calamity can be treated in a manner similar to infill development. That is, areas where it is acceptable should be defined and appropriate conditions should be set. The conditions could be based upon those followed by the local jurisdiction with regard to reconstruction of land uses which are otherwise not in conformance with local plans and zoning. Reconstruction should be limited to a density of use not exceeding that of the original development.

Inverse Condemnation

The material presented in this section is written from a professional planning perspective. It is not a legal opinion.

A concern sometimes raised (especially by landowners) with regard to establishment of airport land use restrictions is that the restrictions might constitute inverse condemnation — a *taking* of private property without just compensation. This is not a new concern. The criteria for compensable takings have long been debated in legal literature. Also, many court cases, including some specifically dealing with airports, have delineated when a taking has or has not occurred. Even as far back as 1952, the report of the President's Airport Commission, *The Airport and Its Neighbors* (the Doolittle commission report, discussed more fully in Chapter 8), devoted several pages to the topic.

Inverse condemnation is a highly complex subject. It is not possible for this *Handbook* to delve into it at length — entire books can and have been written on the topic. Rather, this section is merely a brief summary of the issue as it applies to airport compatibility planning. The emphasis is on the implications for ALUCs.

State law does not give ALUCs direct authority over land use. Implementation of an ALUC's policies is accomplished by the relevant city or county — to the extent that the local government concurs with the ALUC's policies. Therefore, it is a legitimate question whether it is possible for an ALUC policy to result in a taking through inverse condemnation. The local agency which implements the policies could be more readily sued. However, since the issue here concerns the limitations which the potential for inverse condemnation presents in implementation of airport land use compatibility measures, the question of which local agency could most readily be sued is not directly of interest. More to the point is the issue of what forms and degrees of land use restrictions for airport compatibility purposes are legally sound.

Legal Basis for Regulation

The legal basis for local government regulation of land use is well defined by both statutory and case law. Generally, such regulations are founded upon the basic power of the state to enact legislation protecting the public health, safety, morals, and general welfare of its citizens. This authority is typically passed along to municipalities by state enabling legislation. The principal form of land use regulation in most municipalities is zoning. The constitutionality of zoning was upheld in a landmark case decided by the U.S. Supreme Court in 1926 – *Village of Euclid v. Ambler Realty Company*.

In California, the ability of local governments to regulate land use is an exercise of the police power granted by Article XI of the California Constitution. The authority for airport land use commissions to establish land use regulations is provided by Section 21675(a) of the Public Utilities Code. This section states that "in formulating a land use plan, the commission may develop height restrictions on buildings, specify use of land, and determine building standards, including soundproofing ..." (An earlier reference for ALUCs "to achieve by zoning" the purposes of the statutes were deleted from the law in 1982.)

Limits to Land Use Regulation

The fundamental limitation on governments' power to take property is set forth by the Fifth Amendment to the United States Constitution which states: "... nor shall private property be taken for public use, without just compensation." The most direct application of this principle requires the government to pay fair value for property which it condemns for public use by means of *eminent domain* proceedings. It is not necessary, however, for government to dispossess the owner or physically occupy the property in order to have effectively created a taking. A taking can also result through overly restrictive land use regulations.

The legal interpretation of when a government regulation of land use becomes a taking has continually been refined – and, occasionally, modified – as the courts have heard new cases. Although the basic principles have been in effect for some time, their application to a specific set of circumstances is often not a simple task. Even the U.S. Supreme Court has admitted that it has never been able to develop a "'set formula' to determine when 'justice and fairness' require that economic injuries caused by public action be compensated by the government ..." [*Penn Central Transportation Co. v. New York City*, 438 U.S. 104, 124 (1978)].

A succinct recent statement of the basic principles is found in the U.S. Supreme Court's opinion in *Agins v. City of Tiburon* [447 U.S. 255 (1980)]. In that case, the court declared that for a land use regulation to avoid constituting a taking, it must pass two tests:

- It must "substantially advance legitimate state interests" and
- It must not deny the property owner of "all economically viable use of his land."

The following two sections elaborate upon these criteria.

Defining Legitimate Government Purposes

The terms "substantially advance" and "legitimate state interests" as used in the first of these two tests have never been precisely defined by the courts. Over the years, though, many court cases have shed light on the nuances of their meaning. Mostly this has occurred through various rulings regarding the legitimacy of specific regulations which have been challenged.

It is generally easier for courts to find a legitimate public purpose when a land use regulation "prevents a harm" rather than "confers a benefit." One case noted that the purpose of a regulation must be taken into account: "the nature of the State's interest in the regulation is a critical factor in determining whether a taking has occurred ..." [*Pennsylvania Coal Co. v. Mahon*, 260 U.S. 393 (1922)]. An important recent case on this subject [*Nollan v. California Coastal Commission*, 483 U.S. 825 (1987] placed focus on the concept that there must be a *nexus* or connection between the burden on the community created by a proposed private development and the conditions or restrictions placed on that development. Such restrictions must clearly and directly serve to mitigate the burden.

Regulation of land around airports to assure compatibility with the airport is widely held to be a legitimate public purpose. The purpose of all land use regulations, after all, is the reduction of incompatibilities among different types of land uses. The state enabling legislation for airport land use commissions clearly defines the purpose of the statute as being "to protect public health, safety, and welfare by ensuring the orderly expansion of airports and the adoption of land use measures that minimize the public's exposure to excessive noise and safety hazards within areas around public airports ..."

There is, however, a body of legal opinion which suggests that, at some point, measures to protect airports from incompatible land uses become a transfer of rights from one private party to other private parties. That is, owners of land adjacent to an airport give up certain rights (for example, the ability to build structures which would penetrate FAR Part 77 surfaces) which are then given to the users of the airport. In this legal view, no legitimate public purpose is being served and the action is not a valid exercise of the police power. Compensation would be necessary for any such taking unless the property owner has waived this right by failing to take timely action (in California, within five years of the event).

The nexus issue is another takings-related concern that has sometimes arisen of late in the context of airport land use planning. In instances where proposed land uses are marginally incompatible with airport activities, it is the policy of many ALUCs to require the land owner to dedicate an avigation easement to the airport as a condition for finding the proposed development consistent with the commission's compatibility plan. The issue raised is whether there is sufficient nexus — that is, a connection — between the negative effect of the development on the community (specifically, the community's airport) and the condition imposed on the development. To establish this connection, the development must be shown to have the potential for causing harm to the community and the imposed condition must mitigate that harm.

A good case can be made for the required avigation easement dedication in situations involving rezoning of land from an agricultural or other airport-compatible use to an incompatible use such as a residential subdivision. Such a change would have the negative effect on the community of creating a new constraint on the use of the airport — a public facility — and thus would likely constitute a sufficient nexus to warrant imposing the avigation easement as a development condition. On the other hand, the appropriateness of adding an avigation easement dedication condition to land already zoned residential would be difficult to demonstrate unless the ALUC had previously found the local general plan to be inconsistent with the commission's plan with respect to that property.

Determining Reasonable Use of Land

By their very nature, government regulations have direct or indirect effects on property values. In examining whether a taking has occurred in a particular instance, the courts sometimes consider the extent of the resulting change in value of the property. However, when following this approach, the courts look to the value remaining in the property, *not* the value that was taken. Local land use regulations that have resulted in more than a 90% reduction in the value of an individual's land have been upheld as not a taking because sufficient "economically viable" use of the land still remained. Generally though, the greater the range of remaining permitted uses, the easier it is for government to avoid a successful inverse condemnation suit.

Local governments are largely free to change land use designations and zoning at their discretion. Landowners are not entitled to reimbursement for hypothetical losses due to changes in zoning, nor do they have any right to anticipate a change in zoning. Zoning decisions are generally held to be legislative acts and courts will not substitute their judgment for those of elected officials. However, *vested rights* to current zoning are considered to exist when the landowner has obtained:

- A valid building permit, coupled with construction (generally the laying of the structure's foundation) having commenced;
- A vesting tentative map; and/or
- A development agreement with the local government.

Vesting of rights to current zoning does not occur solely because a developer has constructed infrastructure (e.g., roads, and water lines).

In applying these principles to the work of airport land use commissions, a couple of points are noteworthy. One point, previously mentioned in Chapter 1, is that ALUCs can only go so far in restricting land uses for airport compatibility purposes. In locations close to the ends of runways, extreme noise levels, high accident potential, and significant limitations on the height of objects may restrict the choice of land uses to a few types of open space or agricultural functions. None of these land uses may be economically viable in urban areas. In these instances, acquisition of the property may be the only appropriate choice. This is an action which the airport owner must take — ALUCs do not have this authority.

The vested rights issue is pertinent to ALUCs in that it helps to define when a proposed land use becomes existing and thus no longer subject to the commission's review. It is important, therefore, that ALUCs have the opportunity to review land use proposals at an early stage — preferably as a general plan or specific plan action — before they become vested. In some situations, financial commitments or other factors can result in vesting occurring quite early in the development process.

Remedies for Excessive Land Use Regulation

As long interpreted by California courts, the principal remedy in situations where an excessive land use regulation was found to constitute a taking was for the court to invalidate the regulation. A 1987 U.S. Supreme Court decision — *First English Evangelical Lutheran Church of*

Glendale v. County of Los Angeles, 482 U.S. 304, 107 S. Ct. 2378 (1987) — overturned the California rule, however. In this case, the Court held that the U.S. Constitution also requires that the landowner be compensated for a "temporary taking" which occurred while the regulation was in effect. A simple invalidation of the regulation would not be a sufficient remedy for the resulting damages incurred by the landowner.

A separate issue — one that is beyond the scope of the discussion here — is how the amount of monetary damages are to be calculated. The current status might nevertheless be summarized by saying that, much like with the overall issue of determining when a regulatory taking has occurred, the courts have adhered to a case-by-case approach when reviewing the factors affecting the calculation of appropriate damages. Future court decisions will undoubtedly continue to refine how various factors are to be included in the equation.

Economic Considerations

The emphasis of ALUC responsibilities is clearly upon preventing incompatible land use development and preserving the utility of airports. Nevertheless, ALUCs cannot totally ignore the economic implications of providing a high degree of compatibility, especially around airports in urban communities. Whether the purpose is with regard to noise or safety, airport/land use compatibility has its costs as well as its benefits. These opportunity costs are borne not only by the landowner (in not obtaining maximum use of the land), but also by the community as a whole (from underutilized infrastructure, lost taxes, etc.) and even by the airport (if acquisition of the property is the only means of preventing incompatible development).

- **Noise** — The economic implications of noise are somewhat better understood — or at least more often studied — than those of safety. Various studies have concluded that significant airport noise can adversely affect the value of airport vicinity property, particularly residential property near busy air carrier airports (other studies, have found little effect, it should be noted). Regardless of airport proximity, however, land zoned for commercial, industrial, and other uses relatively insensitive to noise typically carries a higher price than residential land. Thus, providing a high degree of noise compatibility by precluding residential development in areas exposed to moderate noise can even increase the land value if sufficient demand for nonresidential land exists. Even in areas of high noise exposure, *some* type of economically viable private use of land is usually possible, although the choices may be limited.

- **Safety** — In rural areas, a high level of safety compatibility can normally be accomplished by preserving agricultural land uses near the airport. However, as discussed in Chapter 9, the choices for safety-compatible land uses in high-risk zones near urban airports are relatively few. Adding to the complexity of the issue is the fact that the tradeoff between the costs of virtually sterilizing an area where safety concerns exist and the benefits of potentially saving lives or reducing property damage is a difficult one to quantify. The question that must be asked is whether, at some point, the incremental cost of establishing restrictions on additional acreage outweighs the incremental safety benefits provided.

The bottom line is that, while airport land use commissions are not obligated to consider economic factors in their planning decisions, cities and counties almost always will. Unless a balance can be found which allows a reasonable degree of both land use compatibility and land use development, many local jurisdictions will proceed in a manner which they perceive to be the most economically advantageous and will override ALUC actions if necessary.

Chapter 4

ALUC Review of Local Actions

4

ALUC Review of Local Actions

OVERVIEW

Review of local agencies' land use plans and airport plans and certain other land use projects and actions is one of the two specific duties of airport land use commissions (preparation of compatibility plans being the other). The process which should be followed in this review depends upon three factors:

- The type of local action involved;
- Whether the ALUC has adopted a compatibility plan; and
- What action the local agency has taken with regard to consistency between its general plan and the ALUC's plan.

This chapter discusses the requirements for ALUC reviews of local actions, the procedures to be followed, and the substance of the reviews. Figures 4A and 4B depict flow charts identifying the steps involved in the ALUC review process for land use actions and airport plans, respectively.

TYPES OF REVIEWS

Mandatory versus Optional Reviews

In the early years of airport land use commissions' existence, state law required that all local plans, projects, and other actions affecting the vicinity of an airport be submitted to the responsible commission for review. For airports located in growing areas, this process proved to be cumbersome. The law was therefore amended to place emphasis on general plans and specific plans as the levels of local planning at which compatibility between airports and their surroundings should primarily be addressed. The current law greatly limits the need for ALUC review of local actions once the ALUC has adopted a compatibility plan and local general plans and specific plans have been made consistent with it.

Airport land use commissions can require the review of "all actions, regulations, and permits" involving the vicinity of a public airport only under two circumstances:

- Prior to ALUC adoption of a compatibility plan for the airport all such actions *shall* be submitted for review (Section 21675.1(b)); and
- When a local agency has neither revised its general plan or specific plan to be consistent with the commission's compatibility plan nor overrided the commission with regard to these plans the ALUC *may* require the local agency to submit all such actions for review (Section 21676.5(a)).

It is important to note, however, that ALUC review of certain types of actions is — or appears to be — still required even after a local agency has made its general plan and any specific plans consistent with the commission's compatibility plan or overrided the commission. As discussed below, the law is clear with regard to the required review of airport plans, but a bit ambiguous with respect to the approval of zoning ordinances and building regulations.

ALUC review of most other types of land use actions — primarily those involving individual development proposals — becomes optional once the general plan and specific plans have been made consistent with the compatibility plan. (The significant exception is any project which requires a general plan, specific plan, or zoning ordinance amendment.) In order for an ALUC to continue to review these individual projects, the local agency must *agree* to have them reviewed (Section 21676.5(b)). This section of the law is not completely clear as to whether an ALUC can continue to require review of individual projects if the local agency has approved its general or specific plans by overriding the commission rather than making the plan consistent with the compatibility plan. The common assumption among many ALUCs, though, is that an override also eliminates the *requirement* for individual project review.

Types of Actions Reviewed

The question of which functions an ALUC should focus on when reviewing each of these types is examined later in this chapter.

To further elaborate upon these basic provisions of the law, it is useful to divide the types of local actions over which ALUCs have review responsibilities into four categories:

- General plans and specific plans;
- Ordinances and regulations;

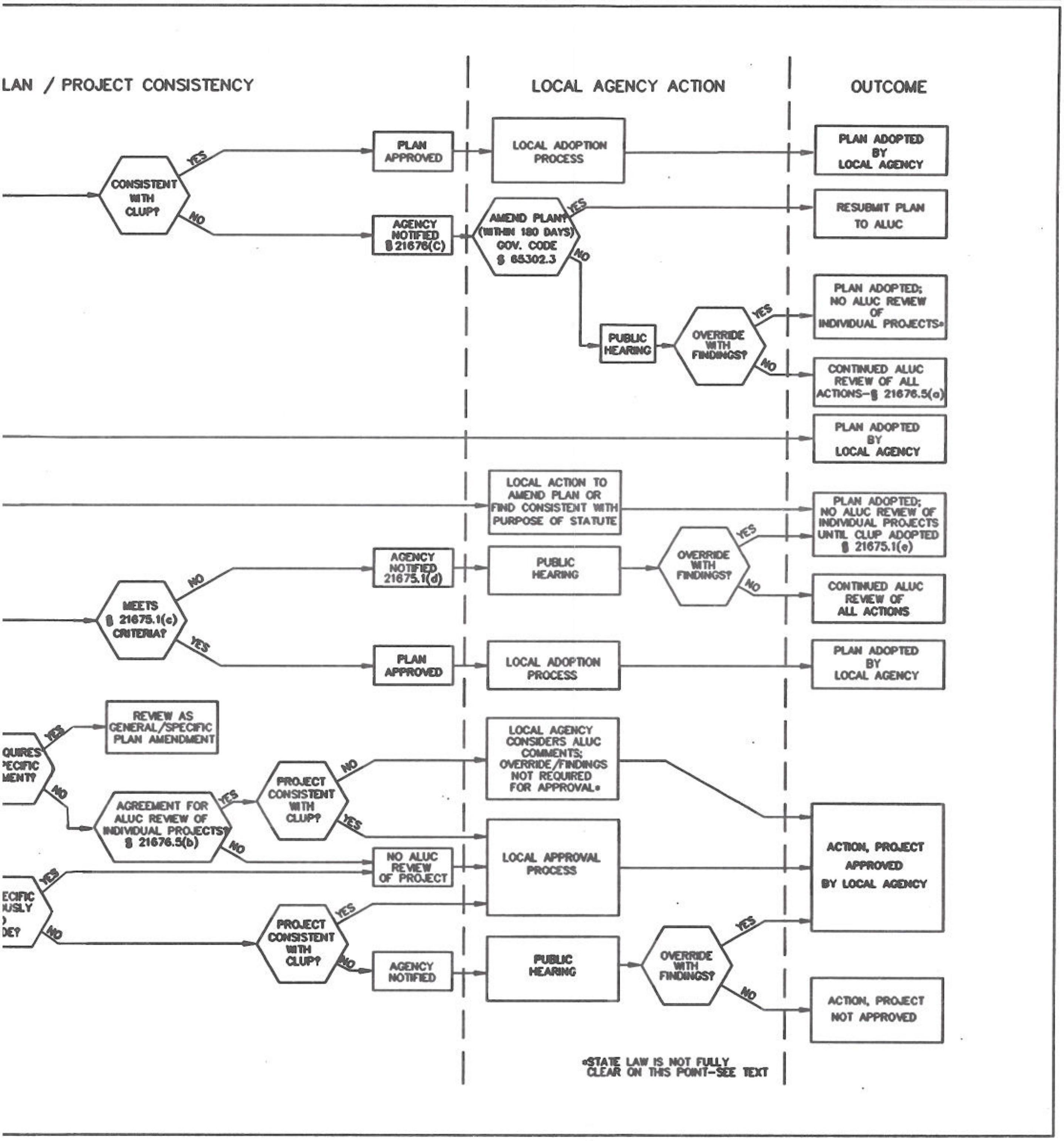


Figure 4A

ALUC Review Process for Land Use Actions

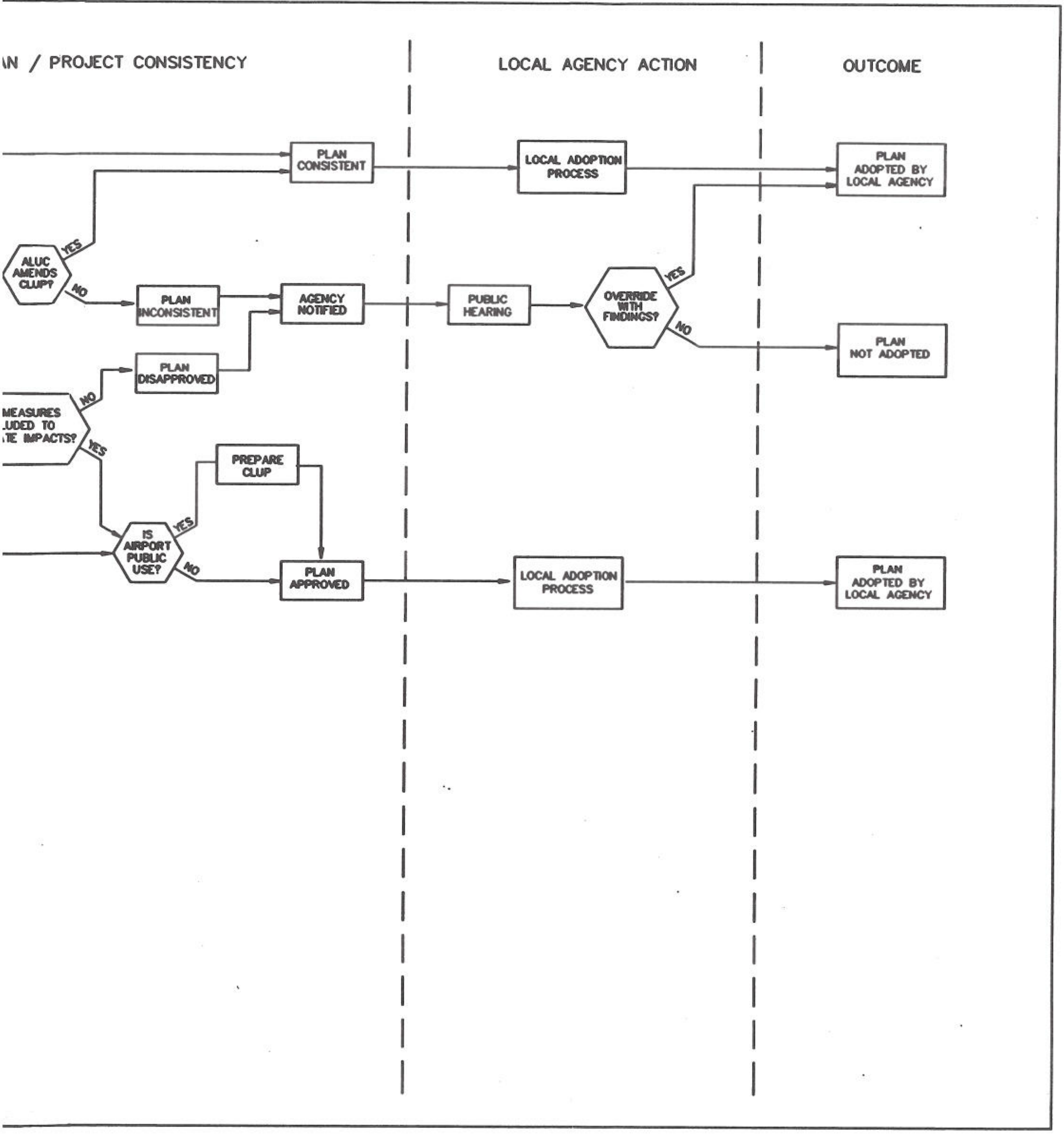


Figure 4B

ALUC Review Process for Airport Plans

In conjunction with its review of a plan, project, or other land use action, an ALUC also may review and comment upon an associated environmental document. ALUCs do not, however, have authority to review environmental documents on actions for which they have no review responsibilities under ALUC statutes.

No review of a local action regarding a general plan or specific plan is optional if the plan encompasses an airport planning area. All such actions must be submitted for ALUC review.

- Individual development projects; and
- Airport plans.

For each of these categories, there are different circumstances which dictate whether ALUC review is required or optional.

General Plans and Specific Plans

Any community general plan or specific plan whose boundaries encompass any part of an ALUC's airport planning area must be reviewed by the commission. This review requirement is initiated by either of two circumstances:

- **Adoption or Amendment of the Compatibility Plan** — One of the first actions an ALUC should take during preparation or following adoption of a new compatibility plan is to review the current general plans and specific plans of each of the affected local agencies (Section 21676(a)). Any inconsistencies between the local plans and the commission's plan should be listed. The local agency should then be notified regarding the findings of the consistency determination. Any amendments to the compatibility plan which may result in inconsistencies with the local plans also will trigger this review process. State law (Government Code, Section 65302.3) then gives affected cities and counties 180 days to amend their plans in response to the compatibility plan adoption or amendment. Alternatively, if the city council or board of supervisors does not concur with the provisions of the compatibility plan, it can make findings that its plans are consistent with the intent of the ALUC statutes and override the ALUC decision by a two-thirds vote.

  (Some ALUCs do not initially review local plans for consistency with a new or amended compatibility plan, but instead wait for the proposed amendments to the local plans to be submitted for review. The above recommendation for a preliminary consistency review is based upon two factors. One, from a practical standpoint, most ALUCs and their staffs have more expertise with which to point out inconsistencies than do local agencies. The process of having local plans become consistent with the compatibility plan should thus be facilitated. Secondly, Section 21676(a) of the Aeronautics Act establishes a process of preliminary compatibility review of local plans by ALUCs. The fact that this section required initial compliance with this process by 1983 should not be construed as meaning that the requirement is no longer in effect. The clear legislative intent was that the identified process of general/specific plan submittal and review should continue beyond the original deadline.)

- **Adoption or Amendment of the General or Specific Plan** — Prior to local agency approval of a new or amended general plan or specific plan affecting an airport vicinity, the plan must be submitted to the ALUC for review. This requirement exists regardless of whether the commission has adopted a compatibility plan for the airport. If a compatibility plan has not been adopted, then the airport vicinity is defined to mean the study area for such plan or the land within two miles of the airport boundary (Section 21675.1(c)). When general or specific plan amendment is proposed for the purpose of making that plan consistent with a compatibility plan amendment, the local agency must act on the amendment within 180 days of the time the compatibility plan was amended (Government Code, Section 65302.3).

Ordinances and Regulations

The state law leaves open to interpretation whether ALUC review of zoning, building, and other land use ordinances and regulations is required after the general plan or specific plan has been made consistent with the commission's compatibility plan or been adopted with an overriding of the commission. Section 21676(b) states that, along with general plans and specific plans, zoning ordinances and building regulations which affect land uses within the commission's established planning boundary must be referred to the ALUC for review prior to approval. This section makes no exception for previous actions regarding the general plan or specific plan. An ambiguity arises, however, because Section 21676.5(b) does not exclude ordinances and regulations from actions no longer subject to further commission review after a general plan or specific plan has been revised or adopted by an override action.

Many ALUCs require that proposed adoption or amendment of land use ordinances and regulations always be reviewed if they have implications for noise or safety compatibility. Regardless of how the law is interpreted, review of these types of planning documents is essential to ensuring land use compatibility because they often contain important noise- or safety-related criteria or standards not defined in detail by general plans and specific plans.

Individual Development Projects

Unlike the above types of land use actions which can encompass an entire community or major portion of it, individual development projects are usually limited in scope to a single parcel or block of land. Also, by definition, actions in this category normally include near-term plans for construction.

Individual development projects are among the "all actions, regulations, and permits" for which review is mandatory or can be required:

- Prior to adoption of a compatibility plan; as well as

- When a general plan or specific plan has not been made consistent with the compatibility plan or approved by overruling the ALUC.

After the local agency has taken action with regard to the consistency of its general plan or specific plan, review of most individual development projects normally occurs only by voluntary agreement between the ALUC and the affected local jurisdiction. It is common for ALUCs and local agencies to establish a list of certain types of major projects for which commission review will be continued.

Examples of Major Individual Development Projects Subject to Voluntary Review Agreements*

- Proposed expansion of a city's sphere of influence.
- Proposed residential development, including land divisions, consisting of five or more dwelling units or parcels.
- Requests for variance from a local agency's height limitation ordinance.
- Major capital improvements (e.g., water, sewer, or roads) that would promote urban development.
- Proposed land acquisition by a government entity (especially, acquisition of a school site).
- Building permit applications for projects having a valuation greater than $1,000,000.
- Any proposal for construction or alteration of a structure (including antennas) taller than 200 feet above the ground at any location within the county.
- Any other proposed land use action, as determined by the local planning agency, involving a question of compatibility with airport activities.

* ALUCs can *require* that these or any other types of individual development projects which involve an amendment to a local general plan, specific plan, or zoning ordinance be submitted for review.

Airport Plans

ALUC review of three categories of airport plans is mandatory in accordance with state law. This review requirement is not affected by any previous action by the local agency regarding its general plan or specific plan.

- **Airport Master Plans** — Section 21676(c) mandates that "each public agency owning any airport within the boundaries of an airport land use commission plan shall, prior to modification of its airport master plan, refer such proposed change to the airport land use commission." The commission must then determine whether the proposed

In the context of the aeronautics law, a *heliport* is considered to be a type of airport. Plans for construction of new heliports are therefore subject to ALUC review.

master plan is consistent or inconsistent with the adopted compatibility plan for that airport.

As used in this section of the law, as well as in the section applying to airport expansion, *construction plans* should be thought of as *construction proposals*. These sections are not intended to require that ALUCs review the actual engineering construction drawings, only the overall layout plan.

- **Construction Plans for New Airports** — The requirement for review of construction plans for new airports arises not out of the airport land use commission portion of the state aeronautics law (Chapter 4, Article 3.5), but from the regulation of airports portion of the law (Chapter 4, Article 3). Section 21661.5 of this article states that no application for the construction of a *new* airport may be submitted to any local, regional, state, or federal agency unless that plan has been both:
  - Approved by the board of supervisors of the county, or the city council of the city, in which the airport is to be located; and
  - Submitted to and acted upon by the appropriate airport land use commission.
- **Airport Expansion Plans** — Section 21664.5 of the Aeronautics Act applies the above review requirements to any *airport expansion* project which entails amendment of the Airport Permit issued by the California Division of Aeronautics. *Airport expansion* is defined to include:
  - The construction of a new runway;
  - The extension or realignment of an existing runway; and
  - The acquisition of runway protection zones or any interest in land for the purpose of the above.

PROCEDURAL CONSIDERATIONS

Information Required for Project Reviews

Most county and city planning departments have a form and/or a defined list of information which a project applicant must submit when requesting zoning variances or other types of local development approvals. ALUCs should have a similar form or list of information to be included when a project is submitted for commission review.

Without adequate information, the commission cannot fully assess whether a proposed land use action will be consistent with the commission's compatibility plan. If this information is not included when the project is submitted for ALUC review, delays may occur if questions arise during a public meeting. Section 21675.2(c) of the ALUC statutes says that:

The text of these sections of the Government Code is included in Appendix A.

"Failure of an applicant to submit complete or adequate information pursuant to Sections 65943 to 65946, inclusive, of the Government Code, may constitute grounds for disapproval of actions, regulations, or permits."

Although this particular section applies to ALUC review of actions prior to the adoption of a compatibility plan, the results can be the same with regard to actions submitted for a consistency review.

ALUC staffs should conduct a preliminary review of the information submitted on a project to assess whether the project is subject to ALUC review and, if so, whether the information is sufficiently complete to enable a consistency determination to be made. If additional information is needed, the project proponent should be so notified without undue delay. Staff also should determine whether the applicant has already requested essential reviews by other agencies, specifically an aeronautical hazard review conducted by the Federal Aviation Administration in accordance with Part 77 of the Federal Aviation Regulations. If at all possible, a situation to be avoided is a delay in ALUC action on a project because insufficient information is available at the time of the commission meeting.

Time Factors

Time is a factor with regard to the project review process in two ways:

One ALUC encourages proponents of individual development projects to submit information on their proposals directly to the commission. These items are then placed on the commission agenda for "discussion purposes only." This process allows many compatibility issues to be resolved before the project is even submitted to the city or county for processing.

- **Timing of Project Submittal** — In order to avoid unnecessary delays in the overall processing of a plan or project, the timing of when the plan or project is submitted to an ALUC for review is an important consideration. In general, plans and projects should be referred to the ALUC at the earliest reasonable point in time so that the commission's review can be duly considered by the local jurisdiction prior to formalizing its actions. Depending upon the type of plan or project and the normal scheduling of meetings, ALUC review *can* be done before, after, or concurrently with review by the local planning commission and other advisory bodies, but *must* be accomplished before final action by the board of supervisors or city council.

- **Response Time Requirement** — An airport land use commission must respond to a local agency's request for a consistency determination on a plan or project within 60 days of referral. However, this response period does not begin until such time as all information necessary for accomplishment of the project review has been submitted to the commission. The 60-day response time is specified in Sections 21675.2(a) and 21676(d) of the State Aeronautics Act.

The consequence of the commission not acting within this time limit depends upon whether the commission has adopted a compatibility plan:

- If the commission has *not* adopted a compatibility plan, the proponent of a land use action, regulation, or permit may petition the court to compel the commission to act on the proposal (Section 21675.2(a)).
- If a compatibility plan has been adopted and the land use proposal involves a general plan, specific plan, zoning ordinance, or building regulation or is a proposed airport master plan, then the proposal is deemed consistent with the commission's plan (Section 21676(d)).

Review of Related Plans and Projects

As discussed earlier in this chapter, a local agency is not required to submit proposed individual development projects for ALUC review after making its general plans and any specific plans consistent with the commission's compatibility plan unless the project involves amendment of the local plan. However, even when a local agency and the ALUC have agreed that selected land use actions will continue to be reviewed, efforts should be made to avoid duplicative reviews.

For example, if a specific plan has been prepared primarily to provide guidance for a major land use development proposal and the plan contains substantial detail regarding the development, subsequent review of the proposal itself should not ordinarily be necessary. Similarly, if the ALUC reviews a proposed zone change related to a particular development project, then later review of the project itself can be avoided if site design and other significant information is provided with the initial review.

Review of Ministerial Actions

A question which sometimes arises, primarily with regard to the review of individual development projects, concerns the appropriateness of ALUC review of projects for which local government approval is ministerial (administrative) as opposed to discretionary. In essence, the question is why should an ALUC review a project if the local agency has no power to deny its approval?

The important factor to remember in these cases is that, even though the local agency may not be able to deny the project, it can set design conditions. In terms of airport compatibility, such conditions might include site layout, height limits, and noise insulation.

Section 21675.1(g) of the state law implicitly indicates that ministerial permits are subject to ALUC review prior to the adoption of a compatibility plan. This section allows ALUCs to exempt ministerial permits for single-family dwellings from review except where 25 percent or more of the parcels in a subdivision are undeveloped. After adopting a compatibility plan, a commission has the option of what types of ministerial actions, if any, it wishes to review. Subsequent to local agency action on its general plan or specific plans, ALUCs only review ministerial permits if the local agency agrees to submit them.

Existing Land Uses

Another procedural question which occasionally arises is what constitutes areas "already devoted to incompatible uses" in accordance with the basic purpose of the ALUC statutes? More to the point is the question of when a proposed land use becomes an existing land use. This issue can be relevant when the ALUC is reviewing general plans and specific plans as well as during any subsequent review of individual development actions.

Also see the discussion under *Inverse Condemnation* in Chapter 3.

In general, ALUCs should follow land use planning laws and conventional practice with regard to the development approval process. This suggests that a vacant property should be considered *devoted* to a particular use, even if the activity has not yet physically begun, once local government commitments along with substantial construction investments by the property owner make it infeasible for the property to be used for anything other than its proposed use. Local government commitment to a proposal can usually be considered firm once a vesting tentative map has been approved or all discretionary approvals have been obtained.

ALUC Action Choices

Land Use Plans and Projects

An ALUC's choices of action on a land use plan or project submitted for review depends upon whether a compatibility plan has or has not been adopted. In either case, the commission has just two basic choices of action available.

- **Prior to Adoption of a Compatibility Plan** — If a commission has not yet adopted a compatibility plan, its choices of action are to *approve* or *disapprove* the matter submitted for review. This choice applies to any type of land use action, regulation, or permit, including general plans, specific plans, zoning ordinances, building regulations, and individual development projects. Absent having an adopted compatibility plan, the commission's authority to approve a land use action, regulation, or permit is limited by the law (Section 21675.1(c)). Approval requires that the commission find, based on substantial evidence in the record, that *all* of the following conditions exist:

- "The commission is making substantial progress toward completion of the plan.
- "There is a reasonable probability that the action, regulation, or permit will be consistent with the plan being prepared by the commission.
- "There is little or no probability of substantial detriment to or interference with the future adopted plan if the action, regulation, or permit is ultimately inconsistent with the plan."

If all of these tests are not met, the commission legally cannot take any action. However, only the first of these conditions is a significant procedural hurdle and very little is necessary to minimally satisfy it. ALUC adoption of a resolution setting an intended schedule for preparation of a compatibility plan should suffice for this purpose. Adoption of preliminary compatibility criteria for the specific airport is not necessary, although the commission's resolution should at least refer to any generalized criteria it may have adopted or to this *Handbook* as the interim basis for project review. Once this test has been met, the characteristics of the project will determine whether the proposed action should be approved or disapproved. If the ALUC still concludes that it cannot take action, approval of the land use proposal would then be subject only to action by the local agency unless court proceedings are initiated by an interested party as discussed later in this chapter.

- **After Adoption of a Compatibility Plan** – After the commission has adopted a compatibility plan for an airport, the nature of its review of land use matters changes. It now has – or should have – a set of policies and criteria by which to evaluate the land use proposal. The question then becomes one of determining whether the proposal is *consistent* or *inconsistent* with the compatibility plan.

  The Aeronautics Act (Sections 21676(a) and 21676.5(a)) mentions only these two choices of action. No mention is made about finding a proposal *consistent with conditions attached*. Nevertheless, some ALUCs have found this to be an acceptable action choice. It is reasoned that such an action saves the applicant the step of returning to the commission with a revised proposal incorporating the commission's conditions for approval. Regardless of which set of action choices an individual ALUC allows for itself, the compatibility plan's policies should indicate what the action choices are.

Airport Plans

When an ALUC reviews an airport master plan, a plan for construction of a new airport (or heliport), or expansion of an existing airport, its basic choices of action are once again to determine whether the proposal is *consistent* or *inconsistent* with the commission's plan. However, there are also associated actions which the commission may wish to take in conjunction with this determination.

- **Airport Master Plans** — When an inconsistency exists between a proposed airport master plan and an adopted compatibility plan, the commission has the option of first modifying its plan to reflect the assumptions and proposals of the master plan. Any such amendment to the compatibility plan is limited to once per calendar year and must follow the procedures outlined in Chapter 2 of this *Handbook*.

- **Plans for New Airports** — Unless a master plan was previously prepared — which typically occurs only when the facility will be publicly owned — the ALUC will not have an adopted compatibility plan for a proposed airport or heliport. As discussed later in this chapter, the consistency determination must therefore be based upon underlying noise and safety compatibility considerations. If the commission concludes that the plan for the proposed facility is consistent with these compatibility factors, it should then decide whether to prepare a compatibility plan for that facility to help protect it from incompatible land use development. If the proposed new airport or heliport will serve the general public, then adoption of a compatibility plan will be required.

- **Airport Expansion Plans** — Plans for expansion of the runway system at a publicly owned airport normally will be based upon a long-range airport master plan previously reviewed by the commission. The consistency review thus need involve little more than a comparison of the proposed expansion project with the airport's master plan. In cases where a master plan does not exist or the expansion project is not included in it, the consistency determination should be based upon factors similar to those for review of plans for new airports.

Reviews by Agreement

Many ALUCs have established agreements with local jurisdictions for continued review of certain individual development projects and other major land use proposals even after the general plan and any specific plans have been made consistent with the commission's compatibility plan. Because submittal of most land use proposals is voluntary under these circumstances, questions then arise as to the significance of the commission's consistency determination. Is the ALUC's review advisory only? More importantly, if the commission finds the proposal to be inconsistent with the compatibility plan, must the local agency override the commission with a two-thirds vote in accordance with the aeronautics law or is a normal majority vote sufficient?

The aeronautics law is lacking in any guidance on this issue. From a practical standpoint, however, the unavoidable conclusion is that ALUC reviews under these circumstances are advisory and the proposals need only a normal majority vote of the local agency for approval unless the agreement specifically states otherwise. If this were not the case, then the local agency could simply cancel the review agreement and proceed without any ALUC involvement.

SUBSTANCE OF REVIEWS

If the adopted compatibility plan for an airport is thorough, the review of proposed local land use actions becomes relatively simple. Some degree of judgment is nonetheless almost always necessary, especially when the compatibility plan relies upon performance criteria rather than a format which specifically indicates the compatibility or incompatibility of individual classes of land uses.

If an ALUC elects to provide comments on an environmental document associated with a project it is reviewing, the focus of the comments should be on matters for which ALUCs have review authority under aeronautics law. Factors such as those listed here are suitable topics for comment.

Discussed below are some of the types of factors which an ALUC and its staff should examine in order to determine whether a proposed action is consistent with the commission's compatibility plan. The list is undoubtedly not totally inclusive. Almost any complex proposal will involve unique details which will need to be considered on a case-by-case basis.

General Plan and Specific Plan Consistency Reviews

Of all the types of land use actions which an ALUC reviews, general plans and specific plans require the most careful scrutiny.

Thorough review of general plans and specific plans is essential for two reasons. One reason is that these documents are often large and complex. Policies and other matters which may be significant with regard to airport compatibility are usually scattered throughout many sections of the plan — land use element and map, transportation element, noise element, safety element, and open space element being among the likely candidates. The second, and perhaps most critical, reason is that once the ALUC has deemed the general plan or specific plan consistent with the compatibility plan, most subsequent land use actions and development proposals will not be reviewed by the commission unless the local agency agrees to submit them.

General plan or specific plan consistency with an ALUC compatibility plan it does not have to incorporate the compatibility plan as is. It must, however, prevent future development of land uses which would conflict

See Chapter 5 for a discussion of land use compatibility strategies from the perspective of local agencies.

with compatibility plan criteria. Also, it must in some way take into account all of the airport-related types of compatibility concerns (specifically including those listed below) even if the implementation details are left to subsequent adoption of a zoning ordinance, building regulation, or other action. In most cases, only if a general plan or specific plan was drafted or revised with explicit attention to airport compatibility issues, is it likely to be consistent with a well-prepared compatibility plan.

General plan or specific plan consistency with a compatibility plan depends a great deal upon the nature of the policies and criteria set forth in the compatibility plan. In general, though, the following factors should be considered in a consistency review:

- **Residential Densities** – How does the number of dwelling units per acre allowed in each designated residential land use category compare with the densities which the compatibility plan considers acceptable for each of the compatibility zones around the airport? For the purposes of this comparison, ALUCs may find it practical to disregard minor discrepancies as long as the compatibility plan's basic noise and safety compatibility objectives are satisfied. For example, the distinction between a residential land use designation which permits 6 dwelling units per acre and an ALUC plan which indicates 5 dwelling units per acre could perhaps be considered inconsequential. The potential for construction of secondary units (sometimes called *granny units*) should be examined, however.

- **Types of Non-Residential Uses** – What specific types of land uses are allowed within the various non-residential general plan or zoning categories? For instance, an agricultural land use category may appear ideal for the vicinity of an airport, but most agricultural designations allow other related uses which may be incompatible with airport activities. Packing sheds and farm labor housing are two examples of potentially high-intensity uses which are permitted in agricultural land use districts. The height of structures also might not be regulated by the local land use plan or zoning ordinance (or may permit taller objects than acceptable for aviation purposes). Schools are another type of use which may be permitted in almost any land use category, but are likely to be incompatible if situated close to an airport.

- **Density of Non-Residential Uses** – General plans and specific plans may divide commercial, industrial, and other non-residential land use categories into various sub-categories based upon the scale and/or nuisance value of the use. However, such divisions usually do not correlate very well to the density of use criteria – measured as the number of people per acre – frequently included in compatibility plans. To be consistent with the compatibility plan, a general plan or specific plan therefore must either: (1) include density of use limitations for land uses near an airport; or (2) divide the land use designations into sub-groups sufficiently defined to allow reliable determination of the maximum probable density of use.

The rationale for open space requirements is examined in Chapters 8 and 9.

- **Open Space Requirements** — Compatibility plan criteria for preservation of certain percentages of open space within an airport vicinity can usually only be satisfied when addressed at the general plan or specific plan levels of planning. Once large blocks of land have been subdivided into individual small parcels, open space requirements having any value to safety compatibility are meaningless. The consistency review should assess whether the general plan or specific plan preserves sufficient functionally useful open land areas near the airport. To be functionally useful, the location, size, and planned uses (including types of landscaping) of the open areas are all important factors.

- **Height Limits** — General plans and specific plans often do not contain policies which limit heights of structures and trees — restrictions on the height of structures are more likely to be found in a zoning ordinance. To be consistent with the ALUC compatibility plan, some reference to height limits, either in general or specifically related to airport airspace requirements, should be included.

- **Easement Dedication Requirements and Buyer Awareness Measures** — Compatibility plans may contain requirements for dedication of avigation easements as conditions for development near an airport. For other areas in the general airport vicinity, implementation of buyer awareness measures, as described in Chapter 5, may be included as an ALUC policy. These requirements should be reflected in the general plan or specific plan for the airport environs.

- **Sound Insulation Requirements** — A compatibility plan requirement for sound insulation of residential and other structures in high-noise-impact areas should be acknowledged in the local plan policies, presumably in the noise element.

See Chapter 3 for a discussion of infill and reconstruction concepts.

- **Existing versus Planned Development** — Most general plans and many specific plans include land use designations both for areas of existing development and areas where development is planned but has not yet occurred. The fact that ALUCs do not have authority over existing incompatible land uses complicates the process of assessing the consistency of these plans.

  One perspective is that, if a local plan is merely reflecting uses which already exist, the plan does not become inconsistent with the compatibility plan even if the indicated uses are not compatible with airport activities. However, for an ALUC to deem a local plan consistent under these circumstances opens up the prospect for the local agency to approve redevelopment of existing land uses in a manner which would remain incompatible with the airport. What is more, such redevelopment, assuming it conforms to the approved local plan, might not even be subject to ALUC review.

As indicated in Chapter 3, a pragmatic approach may be to allow some forms of redevelopment — and infill as well — in locations not highly critical to airport activities and require local plans to designate compatible uses in the most important areas closest to the runways. Local plans should specifically distinguish between areas where redevelopment and infill are acceptable and where they are not. ALUCs should pay close attention to this demarcation during the consistency review process.

Review of Zoning Ordinances and Building Regulations

ALUC review of zoning ordinances, building regulations, site design standards, and other implementing actions should involve the applicable types of considerations outlined above for general plans and specific plans. The significant difference is that these documents usually include criteria, standards, and other details which can be quantitatively compared with related criteria in the compatibility plan. It is important, however, that the ALUC avoid becoming preoccupied with details which do not relate to airport compatibility concerns. Rather, for the following types of actions, attention should focus on components such as these:

- **Land Use Zoning Ordinances** — Residential and non-residential densities allowed in each zoning district should be checked. Allowable height limits also may be relevant.

- **Airport Combining District or Overlay Zoning Ordinances** — Airport-related height limitations, sound insulation requirements, easement dedication requirements, and buyer awareness measures all are possible topics covered in an airport combining district or overlay zoning ordinance. These will need to be reviewed for completeness and currency, as well as general consistency with compatibility plan policies and criteria.

- **Building Regulations** — Sound insulation standards are probably the component of building regulations which most directly relate to compatibility plan concerns.

- **Site Design Standards** — Site design standards should be reviewed with respect to open space requirements established in the compatibility plan.

Review of Individual Development Projects

ALUCs have the right to determine whether specific development proposals meet the commissions' adopted compatibility criteria.

The type and scope of an individual development proposal significantly affects the nature of the review. Many small details play a part in the consistency determination. Among these are:

- **Density of Use** — For residential development projects, the number of dwelling units per acre is routinely indicated. However, the potential number of people per acre who could occupy a non-residential land use may not be clear from the proposal. The building and fire codes applicable to a project are sources of information regarding occupancy types and number of people permitted in a building.

- **Site Plan** — The site plan for a proposed development is essential to review, particularly when a large development straddles more than one ALUC compatibility zone. Does the site plan take into account variations in noise and safety impacts on different parts of a large site? Are functionally useful open space corridors preserved if required by the compatibility plan or local general or specific plan?

- **Height Limits** — The planned height of buildings, antennas, and other objects should be checked if the development is close to the airport or on land higher than the airport elevation. The potential height of trees also may be a factor. Shielding provided by terrain or existing structures should be considered when determining acceptable heights, however.

Airport Plan Reviews

The substance of the review of airport plans — master plans, construction plans for new airports (and heliports), and expansion plans for existing airports — differs depending upon whether the commission has already prepared a compatibility plan for the facility. Consistency is easier to evaluate when a plan for the specific airport has already been created.

Plans for Existing or New Airports with Adopted Compatibility Plans

The review of a master plan, construction plan, or expansion plan for an airport for which a compatibility plan has already been prepared should focus on differences between the plans. *Fundamentally, the question to be examined is whether any components of the airport plan would result in greater noise and safety impacts on surrounding land uses than are assumed in the adopted compatibility plan.* This concept implies that the airport plan does not have to be identical with the compatibility plan as long as the impacts are not increased or moved to previously less-impacted areas.

The airport plan review should focus on elements of the plan which have off-airport impact implications. The proposed location of new taxiways, hangars and other buildings, and so forth thus is not normally significant. Components of the airport plan which should be considered include:

- **Forecasts** — Are the activity forecasts substantially higher than those in the compatibility plan or do they include a higher proportion of larger or noisier aircraft, including helicopters?

- **Runway Layout** — Are any new runways or helicopter takeoff and landing areas proposed? Are changes in runway length, landing threshold locations, or type of approach planned?

- **Flight Tracks** — Will new or modified facilities or aircraft operating procedures result in different aircraft traffic patterns or other changes in where or how high aircraft typically fly when approaching, departing, or flying near the airport?

Construction or Expansion Plans for Airports without Previous Compatibility Plans

When an ALUC reviews a plan for a new airport or heliport — or the expansion of an existing airport or heliport — in an existing land use setting, the basic issue is how will the airport fit into that setting. One way of looking at this issue is to ask: *would the existing or planned land uses be considered compatible with the airport or heliport if the latter were already in existence?* If not, what features are included in the airport or heliport proposal to mitigate the noise and safety impacts on surrounding land uses? These features might include:

- **Aircraft Activity Restrictions** — What type and volume of aircraft activity is projected for the facility over the next 20 years or more? Will any constraints be placed on this activity so as to limit the potential noise and safety impacts?

- **Property Acquisition** — Are the projected airport impacts encompassed within areas for which fee title and/or easements will be acquired?

- **Runway Layout** — Does the proposed layout of aircraft landing areas attempt to limit impacts on surrounding land uses to the extent practical?

- **Flight Tracks** — Will the aircraft traffic pattern be limited to a single side of the runway because of land use compatibility or other conflicts? Are any other flight track or operational restrictions proposed to minimize off-airport impacts?

When reviewing the plans for a new airport or airport expansion, it is important that the ALUC evaluate the adequacy of the facility design (in terms of federal and state standards) only to the extent that the design affects surrounding land use. Also, the commission must base its review on the proposed design. The commission does not have the authority to require alterations to the airport plan.

REVIEW FEES

A 1989 amendment to the state aeronautics law granted ALUCs the authority to charge fees for review of land use proposals and airport plans (Section 21671.5(f)). However, a commission is only permitted to charge fees if it has adopted a compatibility plan for the airport involved. The fees charged cannot exceed the estimated reasonable cost of providing the review.

In a mid-1993 survey, 11 ALUCs (of the 27 responding to the survey) indicated that they charge fees. Most of these commissions charge a flat amount for any type of review. Others distinguish between different types of actions — for example, actions initiated by a public agency (e.g., a new general plan) versus ones which are privately initiated (e.g., individual development projects).

The fees charged for project reviews vary substantially from one ALUC to another. Some commissions charge small amounts which basically cover only the paperwork and other direct expenses. Other commissions base their fees on the typical number of staff hours involved in a project review and attempt to cover the full cost of the staff time.

JUDICIAL ACTION

The state Aeronautics Act (Section 21679) explicitly provides for judicial action on ALUC matters only under very limited circumstances. Specifically, *all* of the following must apply:

- No compatibility plan has been adopted for the airport by an ALUC (Section 21679(a));
- The local general plan or any applicable specific plan does not accomplish the purposes of a compatibility plan (Section 21679(c));
- The local agency action in question must be a zoning change, a zoning variance, the issuance of a permit, or the adoption of regulation (Section 21679(a));

- The local action must affect the use of land within one mile of the boundary of a public airport in the county (Section 21679(a));
- The court proceedings must be initiated by an owner of land within two miles of the airport boundary or an organization with "a demonstrated interest in airport safety and efficiency" (Section 21679(f)); and
- The proceedings must be commenced within 30 days of the local agency action or as otherwise provided in state laws (Section 21679(d)).

If all of these conditions prevail, the court may issue an injunction to postpone the effective date of the local agency action. The postponement remains in effect until the local agency does one of the following:

- Adopts a resolution finding that the action is consistent with the purposes of the ALUC statutes;
- Amends the action to make it consistent with the purposes of the article; or
- Rescinds the action.

Despite the explicitness of this section of the Aeronautics Act, it is generally not regarded as precluding judicial actions on ALUC matters involving other sets of circumstances. ALUCs theoretically could initiate court proceedings to seek to enforce local agency compliance with provisions of the ALUC statutes. Whether most commissions have the financial means and political will to do so is another matter. More common has been for such actions to be brought by pilots' groups or other private parties having an interest in protecting the airport from incompatible development.

Chapter 5

Responsibilities of Local Agencies

5

Responsibilities of Local Agencies

PROMOTING LAND USE COMPATIBILITY

This chapter examines the obligations and responsibilities of local land use jurisdictions and airport operators with regard to airport land use compatibility.

Effective airport land use compatibility planning is not and cannot be solely a function of airport land use commissions. Indeed, as outlined in Chapter 1, state law specifically limits ALUC authority over various actions which directly affect compatibility. Much of the responsibility for airport land use compatibility clearly remains with local agencies whether in the role of controlling land use or operating an airport. This local agency responsibility will become increasingly important now that establishment and operation of airport land use commissions is no longer mandated by state law.

If their objective is to promote land use compatibility around airports within their jurisdictions, cities and counties have the powers to accomplish much more than airport land use commissions have the authority to do. Making general plans and specific plans consistent with an ALUC's compatibility plan is but one step. Other strategies are also available either in conjunction with measures to achieve consistency or, particularly in counties where there is no functioning ALUC, as independent actions.

Local Plans Consistency with Compatibility Plan

Concept of Consistency

A dictionary definition of *consistency* says "agreement or harmony of parts or features to one another or a whole." Legal definitions of the term depend upon the context in which it is used and have been the subject of numerous court cases. It is not a purpose of this *Handbook* to attempt to establish a legal definition for the term. Rather the intent here is to describe what *consistency* generally means with respect to airport land use compatibility planning.

The ALUC statutes of the State Aeronautics Act talks about the need for *consistency* primarily in three contexts:

- When reviewing local plans, projects, and other actions, an ALUC determines whether the proposed action would be *consistent* or *inconsistent* with the commission's compatibility plan.
- Cities and counties should amend their general plans and specific plans so as to be *consistent* with the compatibility plan.
- To override an ALUC decision, a local agency must make findings that its proposed action is *consistent* with the purposes of the ALUC statutes.

As widely applied in airport land use planning, *consistency* does not require being identical. It means only that the concepts, standards, physical characteristics, and/or resulting consequences of a proposed action not conflict with the intent of the law or plan to which the comparison is being made.

Means of Achieving Consistency

Local plans can be made consistent with an ALUC's compatibility plan through various means. Which ones are most suitable depends in part upon how the compatibility plan was prepared and the format of its policies and criteria. As discussed in Chapter 3, some compatibility plans rely primarily upon performance-type criteria while others use list-oriented criteria or detailed land use mapping.

Four general strategies for achieving consistency are outlined below.

- **Adoption of ALUC-Prepared Compatibility Plan as Element of Local Plan** – One simple strategy used on occasion is local government adoption of the ALUC-prepared compatibility plan as an element of the general plan or specific plan. Unless the compatibility plan is highly detailed, this method requires that other local actions, such as one or more of the three listed below, be taken to implement the policies and standards. Also, modifications to other sections of the local plan, particularly with regard to the designation of land uses, may be necessary to ensure internal consistency.

- **Modification of Local Plans to Incorporate Compatibility Concepts** – The most common means of achieving local plan consistency with a compatibility plan is to modify the local plan where necessary to reflect compatibility plan concepts and criteria. This often means changing the type of land use designated for areas most impacted by airport activities. It usually also requires establishment of policies limiting the density of use in nonresidential zones. Policies setting open space requirements or, alternatively, mapping of open areas to be preserved, may be necessary as well.

In accordance with Government Code Section 65302.3, a local agency must act within 180 days of a compatibility plan amendment to either modify its general plan and applicable specific plans or to approve findings and override the ALUC.

- **Adoption of Airport Combining District or Overlay Zoning Ordinance** — Local government adoption of an airport combining district or overlay zoning ordinance is a way of codifying airport compatibility criteria identified in the general plan or specific plan only in concept. This strategy is discussed more extensively in the following section of this chapter.

- **Adoption of Combined Specific Plan and Compatibility Plan** — As mentioned in Chapter 2, some compatibility plans are prepared not as independent ALUC documents or as part of an airport master plan, but jointly with a specific plan for the airport vicinity. Assuming that a plan prepared in this manner addresses all of the important compatibility concerns, it can be adopted in its entirety both by the ALUC as a compatibility plan and the local agency as a specific plan.

Land Use Compatibility Strategies

If airport land use compatibility objectives are to be obtained, cities and counties must take direct actions such as those described here.

Beyond the issue of achieving mandated consistency between local plans and an ALUC's compatibility plan is the broader question of what local governments can do to preserve and enhance compatibility between airport activities and the land uses around the airport. Several strategies are available which can help attain this objective. If the local agency takes land use actions such as the ones discussed here, any inconsistencies between its general plan or specific plan and the ALUC's compatibility plan are likely to be few. Of equal or greater significance, though, is a factor which results from the recent changes in state law making airport land use commission optional. In counties which choose to disband their ALUC as the law now allows, airport land use compatibility will become increasingly dependent upon strong actions taken by the local land use jurisdictions.

Land Use Designations

If compatibility between an airport and its surroundings is to be achieved, designation of appropriate land uses is essential. This is particularly true in developing areas — good planning now can avoid significant conflicts later. The value of designating compatible land uses in built-up areas should not be overlooked, however. Appropriate designations can either help maintain land uses which are already compatible or encourage gradual change of currently incompatible uses to ones which are better suited to the environs of an airport.

The designation of land uses occurs in general plans and specific plans and also in land use zoning ordinances. State law requires consistency among these documents as well as with an ALUC compatibility plan. However, as essential as the designation of appropriate land uses is to airport land use compatibility, reliance on the normal form of these documents will not provide very adequate long-term compatibility assurance. In terms of airport land use compatibility, all have limitations which need to be recognized.

- **Ease of Change** — Nothing permanently locks in a land use designation. When pressured by landowners to allow less restricted development, future local legislative bodies can change the established designations — by overriding the ALUC, if necessary. Such changes especially can occur if the land changes jurisdiction (e.g., as a result of annexation).

For additional discussion of inverse condemnation, see Chapter 3.

- **Restrictiveness** — Land use designations are limited as to how restrictive they can be. If they are deemed to eliminate all reasonable economic use of private property, they can be considered an unfair taking and result in inverse condemnation. Especially in areas near ends of runways, the restrictions may need to be more severe than can be accomplished by land use designations.

- **Lack of Retroactiveness** — Designating an area for a different use than the one already existing may encourage change over the long run, but it does not directly eliminate existing incompatible uses. Other devices, such as fee simple acquisition, may be necessary to bring about the changes.

- **Nonaviation Orientation** — Standard land use plan and zoning designations are developed for community-wide planning purposes. Seldom do they have an aviation orientation or address the specific issues of compatibility with aviation activities (i.e., noise and safety). The Chapter 4 discussion of factors to be considered in a consistency review of a local general plan or specific plan highlights many of the reasons why consistency between local plans and a compatibility plan is seldom achieved without explicit consideration of aviation issues.

Overlay Zones or Combining Districts

One way local governments can overcome the lack of aviation orientation of basic land use designations is adoption of an overlay zone or combining district. A combining district supplements local land use designations by adding specific noise and, often more importantly, safety criteria (e.g., maximum number of people permitted on the site, site design and open space criteria, height restrictions, etc.) applicable to future development in the airport vicinity. Geographically, the combining district should extend at least a mile from the runway ends and encompass lands regularly overflown by aircraft at or below traffic pattern altitudes.

An airport overlay zone has several important benefits. Most importantly, it permits the continued utilization of the majority of the design and use guidelines contained in the existing general plan and zoning ordinance. At the same time, it provides a mechanism for implementation of restrictions and conditions that may apply to only a few types of land uses within a given land use category or zoning district. This avoids the need for a large number of discrete zoning districts. It also enables general plans and specific plans to attain consistency with a compatibility plan through reference to basic compatibility criteria rather than through redefinition of existing land use designations.

An airport overlay zoning ordinance might include some or all of the following elements:

- **Airspace Protection** — A combining district can establish restrictions on the height of buildings, antennas, trees, and other objects as necessary to protect the airspace needed for operation of the airport. These restrictions should be based upon the current version of Federal Aviation Regulations (FAR) Part 77, *Objects Affecting Navigable Airspace*, Subpart C. Provisions prohibiting smoke, glare, bird attractions, and other hazards to flight should also be included.

- **FAA Notification Requirements** — Combining districts also can be used to ensure that project developers are informed about the need for compliance with the notification requirements of FAR Part 77. Subpart B of the regulations require that the proponent of any project which exceeds a specified set of height criteria submit a *Notice of Proposed Construction or Alteration* (Form 7460-1) to the Federal Aviation Administration prior to commencement of construction. The height criteria associated with this notification requirement are lower than those spelled out in Part 77, Subpart C, which define airspace obstructions. The purpose of the notification is to determine if the proposed construction would constitute a potential hazard or obstruction to flight. Notification is not required for proposed structures that would be shielded by existing structures or by natural terrain of equal or greater height, where it is obvious that the proposal would not adversely affect air safety.

Excerpts from FAR Part 77 and a copy of Form 7460-1 are included in Appendix E.

- **Maximum Densities** — Airport noise and safety compatibility criteria are frequently expressed in terms of dwelling units per acre for residential uses and people per acre for other land uses. These standards can either be directly included in a combining zone or used to modify the underlying land use designations. For residential land uses, the correlation between the compatibility criteria and land use designations is direct. For other land uses, the implications of the density limitations are not as clear.

  One step that can be taken by local governments is establish a matrix indicating whether each specific type of land use is compatible with

Several exhibits in Appendix C depict detailed land use lists of this type.

each compatibility zone. To be useful, the land use categories will need to be more detailed than typically provided by general plan or zoning ordinance land use designations.

- **Designation of High Noise-Impact Areas** — California state statutes require that multi-family residential structures in high-noise exposure areas be constructed so as to limit the interior noise to a Community Noise Equivalent Level of no more than 45 dB. A combining district could be used to indicate the locations where special construction techniques may be necessary in order to assure compliance with this requirement. The combining district also could extend this criterion to single-family dwellings.

The concept of clustering of development as it relates to the risks associated with aircraft accidents is examined in Chapter 9.

- **Open Areas for Emergency Landing of Aircraft** — In most circumstances in which an aircraft accident occurs near an airport, the aircraft is under control as it descends. When forced to make an off-airport emergency landing, pilots will usually attempt to do so in the most open area readily available. Airport compatibility plans often contain criteria establishing open space requirements for this purpose. These criteria are most effectively carried out by planning at the general or specific plan level, but may also need to be included in a combining district so that they will be applied to development of large parcels. Adequate open areas can often be provided by clustering of development on adjacent land.

- **Airport Traffic Pattern Delineation** — Depiction of the locations overflown by aircraft at or lower than traffic pattern altitude can be a useful element of an airport overlay zone. Buyer awareness program measures, such as those described below, can be tied to the area delineated.

A legal consideration which supports the value of this concept is that down-zoning of a property to a less intensive use is becoming more difficult. It is much better not to have inappropriately upzoned the property in the first place.

- **Areas of Special Compatibility Concern** — A significant drawback of standard general plan and zoning ordinance land use designations is that they can be changed. Uses that are currently compatible are not assured of staying that way in the future. Designation of areas of special compatibility concern would serve as a reminder that airport impacts should be carefully considered in any decision to change the existing land use designation.

Buyer Awareness Measures

Buyer awareness is an umbrella category for several measures whose objective is to ensure that prospective buyers of airport area property, particularly residential property, are informed about the airport's impact on the property.

- **Dedication of Avigation Easements** — As a means of assuring buyer awareness, some communities — many times in response to ALUC

See Chapter 3 for a discussion of inverse condemnation as it relates to ALUC plans and policies.

policies — require that developers of property near an airport dedicate an avigation or overflight easement to the airport as a condition for approval of the development. This approach is particularly common with residential development, but has also been applied with regard to other land uses. In recent years, however, the legality of requiring avigation easement dedication has sometimes been questioned, particularly in circumstances where buyer awareness is the primary objective. A connection (*nexus*) between the easement dedication requirement and the negative consequences of land use development near an airport can more readily be made in locations where substantial noise and safety impacts can be demonstrated. Regardless of whether the nexus concern is valid in many circumstances, other forms of buyer awareness may be equally effective and simpler to implement.

An example of a deed notice is included in Appendix D.

- **Recorded Deed Notices** — A deed notice is an official statement which is recorded in county records as part of a tentative or final subdivision map prepared at the time a parcel is subdivided. As used for airport compatibility planning, the purpose of a deed notice is to disclose that the property is subject to routine overflights and associated noise and other impacts by aircraft operating at a nearby airport. Because this information becomes part of the deed to each property in the subdivision, it should show up in a title report prepared when one of the parcels is being sold.

  In one sense, deed notices are similar to avigation or other aviation-related easements in that they become part of the title to a property and thus are a permanent form of buyer awareness. The distinguishing difference between deed notices and avigation easements is that deed notices only serve as a disclosure of potential overflights (and the property's location within an airport combining district and/or ALUC planning area), whereas avigation easements convey an identified set of property rights. In locations where height limitations or other land use restrictions are unnecessary, deed notices have the advantage of being less cumbersome to define. Also, they give less appearance of having a negative affect on the value of the property. An ideal application of deed notices is as a condition of approval for development of residential land uses in airport-vicinity locations where neither noise nor safety are significant factors, but frequent aircraft overflights might be annoying to some people.

As discussed at the end of this chapter, airport proprietors also can carry out a real estate disclosure program, although generally on a less formal basis than can be accomplished by the local land use jurisdiction.

- **Real Estate Disclosure Statements** — A less definitive, but more all-encompassing, form of buyer awareness program is to require that information about an airport's influence area be disclosed to prospective buyers of all airport-vicinity properties prior to the transfer of title. The advantage of this type of program is that it applies to previously existing land uses as well as to new development. This requirement already exists in California state real estate law, but it can be reinforced by local policy established in conjunction with the adoption of an airport combining zone. Notification describing the zone and discussing its significance could be formally sent to all local real estate brokers and title companies. Having received this information, the brokers would be obligated by state law to pass it along to prospective buyers.

At a minimum, the area covered by a real estate disclosure program should include the airport planning area as established by the compatibility plan. The boundary also could be defined to coincide with the boundaries of an airport combining zone.

SUBMITTING PROJECTS FOR REVIEW

Reviews by Airport Land Use Commissions

Also see Chapter 4 for a discussion of this topic from the perspective of ALUCs.

In counties where an airport land use commission exists, the obligations of cities and counties with regard to submitting land use projects and other actions for the commission's review are well defined in the state law. The types of projects to be submitted depends upon:

- Whether a compatibility plan has been adopted by the ALUC;
- What action the city or county has taken with regard to making its general plan or specific plan consistent with the compatibility plan;
- Whether the project requires an amendment to the local general plan, specific plan, or zoning ordinance; and
- Whether voluntary agreements for the review of projects have been established.

Local agencies also are obligated to submit airport plans for ALUC review.

Any environmental documents prepared in conjunction with these actions also should be submitted for ALUC review.

The requirements for project review can be summarized as follows:

- **General Plans and Specific Plans** – Under all circumstances, any proposed adoption of a new plan or amendment of an existing plan must be referred to the ALUC for review prior to final action by the local agency if the plan affects land within the commission's established airport planning boundary (Section 21676(b)). This includes amendments proposed for the purpose of making a general plan or specific plan consistent with an ALUC's compatibility plan. Amendments for compatibility plan consistency purposes should be submitted for review early enough to allow ALUC response and local agency adoption within the 180-day time period specified by the Government Code.

For example, proposed ordinances or regulations involving allowable land uses, densities, structure heights, or sound insulation must be submitted for ALUC review. Architectural standards, sign regulations, and other such matters which clearly do not have airport land use implications are not appropriate for ALUC review.

- **Ordinances and Regulations** — Proposed zoning ordinances and building regulations also must be submitted for ALUC review before being acted upon by the local agency if they affect the compatibility of land uses located within an airport planning area (Section 21676(b)). Although the law is slightly ambiguous on this matter, most ALUCs require referral of ordinances and regulations regardless of whether the associated general plan or specific plan has already been deemed consistent with the compatibility plan or has been adopted through the override procedure.

- **Individual Development Projects** — ALUC review of all permits and other actions related to individual development proposals is required only prior to the commission's adoption of a compatibility plan for the airport involved. This requirement includes referral of actions which are ministerial (see discussion in Chapter 4). Subsequent to a compatibility plan's adoption, local agency referral of individual development projects becomes voluntary unless the project entails an amendment to the local general plan, applicable specific plan, or zoning ordinance (Section 21676.5(b)).

  Nevertheless, local agencies are encouraged to form an agreement with the airport land use commission for review of major land use development project proposals. A tabulation in Chapter 4 lists examples of such projects. A factor to bear in mind with voluntary project-review agreements is that the ALUC's review is regarded as advisory only. The override procedures which must be followed with respect to mandatory reviews are not in effect.

- **Airport Plans** — Proposed airport master plans, expansion of an existing airport, and plans for construction of a new airport (or heliport) must be submitted to the ALUC for review in accordance with Sections 21676(c), 21661.5, and 21664.5, respectively. This referral requirement is independent of whether the ALUC has previously adopted a compatibility plan or the city or county has taken action with regard to the consistency of its general plan or specific plan.

Reviews by Other Agencies

The lack of an established, functioning airport land use commission in a county does not eliminate all responsibilities of local agencies with regard to the review of land use actions which affect airports. Review of certain proposed local land use actions by other agencies is desirable or in some cases required.

Federal Aviation Administration

The FAA's involvement in the review of local projects derives both from its authority over navigable airspace and its function as a funding agency for airport planning studies and airport improvement projects.

The FAA's review does not consider the type of land use involved. Neither does the FAA approve or disapprove the proposal; it merely evaluates and recommends.

- **Aeronautical Studies** — As noted earlier in this chapter (page 5-5), Federal Aviation Regulations Part 77 requires that anyone proposing to construct an object which could affect the navigable airspace around an airport submit information about the proposed construction to the FAA. The FAA then conducts an aeronautical study, the outcome of which is a determination as to whether the object would be a potential hazard to air navigation. If the proposed object is concluded to pose a hazard, the FAA may object to its construction, examine possible revisions of the proposal to eliminate the problem, require that the object be appropriately marked and lighted as an airspace obstruction, and/or initiate changes to the aircraft operational procedures for the airport so as to account for the object.

- **Airport Improvement Program Grants** — Through its Airport Improvement Program (AIP) grants, the FAA currently funds 90% of the cost of most planning studies and eligible improvement projects at airports in California. The FAA reviews airport layout plans and plans for federally funded construction to ensure compliance with Federal Aviation Regulations and airport design standards. As a condition for receipt of a grant, an airport project sponsor must assure the FAA that appropriate actions will be taken to maintain compatible land uses in the airport vicinity.

California State Department of Transportation

The Caltrans Division of Aeronautics has review and, in certain cases, permitting authority with respect to several types of airport and airport-related land use actions. These include:

- **Airport Permits** — Caltrans has authority under the State Aeronautics Act to issue permits for the approval of airport sites and the operation of airports (Section 21662). Moreover, other than for a few limited exceptions, it is unlawful for any political subdivision or any person to operate an airport unless the airport has a valid state permit (Section 21663). The law spells out the conditions for issuance or amendment of an airport permit.

- **Regulation of Obstructions** — A state permit is also required for construction of objects that would affect the navigable airspace. These objects include:
  - Any structure taller than 500 feet above ground level, unless the height of the structure is required to be approved by the Federal

Communications Commission or the Federal Aviation Administration (Section 21656).

- Any structure or object of natural growth which would exceed the height limits specified in Federal Aviation Regulations Part 77, Subpart C, unless the FAA has determined that the object's construction, alteration, or growth would not constitute a hazard to air navigation or otherwise create conditions unsafe for air navigation (Section 21659).

The contents of the Education Code sections are included in Appendix A.

- **School Site Reviews** — A section of the California Government Code (15854.5) and several sections of the Education Code (39005, 39006, 39007, and 81033) require the Division of Aeronautics to investigate and make recommendations on the acquisition of property for a new elementary or secondary school or community college site or for an addition to a present site located within two miles of an airport runway or potential runway included in an airport master plan. The primary factors considered in this review are aircraft accident exposure and aircraft noise. If an ALUC exists and has prepared a compatibility plan for the airport, the Division will generally seek the commission's comments and follow the criteria set in the commission's plan.

- **State Building Site Reviews** — A review process similar to that for school sites is established by a section of the Aeronautics Act (Public Utilities Code, Section 21655). This section requires that the Division of Aeronautics be notified of any state agency proposal to acquire a site for a state building if such site is within two miles of an airport runway. The Division then investigates the site and reports its recommendations to the agency.

- **California Environmental Quality Act Reviews** — Another avenue through which the Division of Aeronautics becomes involved in local projects is through the California Environmental Quality Act (CEQA). As a responsible agency having permitting authority for airports, the Division reviews and comments upon environmental impact documents prepared for airport master plans and airport improvement projects. The Division also frequently comments upon environmental documents associated with local general plans, specific plans, and individual development projects near airports.

Regional Planning Agencies

Most of the single- or multi-county regional planning agencies in the state have responsibilities for reviewing grant applications and setting regional priorities for the use of federal and state grant funds. These agencies also frequently review and comment upon airport master plans and environmental documents for airport plans and improvements.

Airport Proprietors

No state laws require the participation of airport proprietors in the review of proposed land use development in the airport vicinity. These agencies are nevertheless often the most knowledgeable about the effects which nearby development would have upon the operation of their airports. *Proponents of major development projects and the local agencies which have land use jurisdiction over airport environs are urged to seek the input of airport management when preparing community plans and plans for development.*

Reviews in Counties without ALUCs

Cooperative review agreements can be an effective alternative strategy for avoiding future compatibility concepts which will adversely affect both the airport and the surrounding area.

Several counties in the state do not have ALUCs or at least ones that are actively involved in reviewing local plans and projects. Furthermore, the new non-mandatory status of ALUCs means that additional commissions may become inactive or be formally disbanded. Despite the change in the law, the fact that the overall ALUC statutes remain in effect strongly suggests that the legislature continues to recognize the importance of airport land use planning. The question thus becomes one of how to best accomplish the purposes of the ALUC statutes in counties where there is no ALUC.

The current law gives no explicit guidance on this issue. Nevertheless, the key elements of such a review process can be implied from various provisions of the statutes.

- **Airport-Explicit Compatibility Plan** — In counties where an ALUC exists, cities and counties must amend their general plans and applicable specific plans to be consistent with the ALUC's compatibility plan. Even when there is no ALUC, local agencies should take similar steps. First, a plan — similar to one an ALUC would prepare — should be developed which explicitly focuses on airport land use compatibility issues. It should include a defined airport influence area and compatibility criteria (for noise, safety, airspace protection, and overflight concerns) applicable to land use development within that area. The plan could then be adopted as an element of the general plan, but, more importantly, it should be used as the basis for amendment of the land use, noise, safety, and any other relevant elements of the general plan and specific plans.

- **Special Review Process** — Proposals for major land use development within the airport influence area should specifically be reviewed for consistency with the airport land use compatibility criteria. A list of the types of projects subject to this review should be established. When action on the proposal involves discretionary approval by the city or county, specific *findings* should be made that either (1) the proposal is consistent with the compatibility criteria or (2) other overriding land use factors are of higher priority to the community.

- **Inter-Agency Agreements** – One of the reasons for ALUCs is to facilitate coordination of planning between agencies having land use jurisdiction around airports and agencies which own the airports. In counties without ALUCs, formal inter-agency agreements should be established between the affected entities for each airport. These agreements should refer to the compatibility plan and the project review process, as well as to any adopted airport plans. Information on land use development in the vicinity of an airport should be provided to the agency (or private party) owning the airport for review and comment. Also, airport operators should inform surrounding jurisdictions about any proposed changes in airport development or operation which could affect surrounding land. Any comments received should then be treated in the manner otherwise required for the action involved.

OVERRIDE PROCESS

Various sections of the airport land use commission statutes provide for local agencies to override ALUC decisions on land use matters and airport master plans. The override process involves three mandatory steps:

- The holding of a public hearing (except when a city or county overrides a commission disapproval of an action prior to adopting a compatibility plan);
- The making of specific findings that the action proposed is consistent with the purposes of the ALUC statute; and
- Approval of the proposed action by a two-thirds vote of the agency's governing body.

Note that a 1992 opinion of the state Attorney General concluded that a two-thirds vote of the entire membership of a city council or board of supervisors is not necessary for an override; a two-thirds vote of the members constituting a quorum is sufficient.

Two particular aspects of the override process warrant further examination. One is the issue of what constitutes valid findings under the provisions of the law. The other involves the subsequent implications of an override action.

Findings

A requirement for a local agency to make specific findings in conjunction with a decision to override an airport land use commission action is included in six separate sections of the ALUC statutes. In each case, the law provides that the findings must show that the proposed local agency action "is consistent with the purposes of this article stated in Section

21670." A city or county cannot simply override an ALUC decision without first documenting the basis for the override action and relating that basis directly to the purposes for which the ALUC statutes were adopted. The purpose of findings is to assure compliance with state law.

The Concept of Findings

A document prepared by the Governor's Office of Planning an Research (OPR), *Bridging the Gap: Using Findings in Local Land Use Decisions* (last updated in 1989), examines the subject of findings at length. The purpose here is only to highlight key factors, particularly as they apply to local agency overrides of ALUC decisions.

These comments do not constitute a legal opinion regarding the requirements for use or adequacy of findings. Local agencies should consult with their respective legal counsels on these matters.

Requirements for a government entity to make findings of fact when taking certain actions appear in many parts of state law. Also numerous court cases have dealt with the issues of findings and their adoption. The most important case regarding the use of findings in local land use decisions was *Topanga Association for a Scenic Community v. County of Los Angeles* ([1974] 11 Cal. 3d 506). In its ruling on this case, the Court defined findings, explained their purposes, and outlined when findings are needed in making local land use decisions.

Findings were defined in the decision as legally relevant conclusions that explain the decision-making agency's method of analyzing facts, regulations, and policies and the rationale for making the decisions based on the facts involved. Findings are used to show how local decision-makers arrived at their decision based on facts and established policies.

The *Topanga* court also outlined five purposes for making findings. Findings should:

- Provide a framework for making principled decisions, enhancing the integrity of the administrative process;
- Help make analysis orderly and reduce the likelihood that the agency will randomly leap from evidence to the conclusions;
- Enable the parties to determine whether and on what basis they may seek judicial review and remedy;
- Apprise a reviewing court of the basis for the agency's action; and
- Serve a public relations function by helping to persuade the parties that administrative decision making is careful, reasoned, and equitable.

In its review of findings requirements, OPR offers several guideiines regarding what constitutes sound, legally sufficient findings. Perhaps most basic among these guidelines is that *findings must be substantive*, not just recitations of the law: "Generally, findings are not sufficient if they merely recite the very language of the local ordinance or state statute that requires them." In other words, findings must "bridge the analytical gap between raw data and ultimate decision." Findings made by a local commission composed of laymen can be informal, however. They are not required to meet the standards of judicial findings of fact.

The necessity for adequate findings to accompany a local agency's overriding of an ALUC was affirmed in a 1992 court case, *California Aviation Council v. City of Ceres*. In this case the court found that the Ceres city council had merely referred to the ALUC statutes and then concluded that the proposed land uses minimized public exposure to excessive noise and safety hazards in the airport area. The findings did not document the critical links between the proposal, the finding, and the facts.

See Chapter 1 (page 1-1) or Appendix A of this *Handbook* for the complete text of Section 21670(a).

Findings Accompanying an Override of an ALUC Decision

In general, California law does not clearly distinguish between situations which require findings and those which do not. However, with respect to a local agency's action to override an ALUC decision, the law is quite specific. Any such override action — whether it involves a general plan, an individual development proposal, an airport master plan, or other local project reviewed by the ALUC — must be accompanied by specific findings of fact supported by substantial evidence.

The essential substance of the findings which accompany a local agency override of an ALUC decision is indicated in the ALUC statutes. The findings must demonstrate that the proposed action "is consistent with the purposes ..." of the statutes as set forth in Section 21670. Examination of Section 21670(a) indicates that five separate purposes for the legislation are stated:

- "... to provide for the orderly development of each public use airport in this state ..."
- "... to provide for the orderly development of ... the area surrounding these airports so as to promote the overall goals and objectives of the California airport noise standards ..."
- "... to provide for the orderly development of ... the area surrounding these airports so as ... to prevent the creation of new noise and safety problems."
- "... to protect the public health, safety, and welfare by ensuring the orderly expansion of airports ..."
- "... to protect the public health, safety, and welfare by ... the adoption of land use measures that minimize the public's exposure to excessive noise and safety hazards within areas around public airports to the extent that these areas are not already devoted to incompatible uses."

Although findings do not need to address each of these purposes point by point, it is essential that, collectively, all of the purposes be addressed. The following paragraphs outline possible approaches to demonstrating a proposed action would indeed be consistent with these purposes.

- **Providing for Orderly Development of the Airport** — The findings should document:
  - How the local agency has considered any adopted long-range development plans that may exist for the airport;
  - How the local agency intends to plan for development of the airport over the next 20 years; and

- If the master plan identifies a need for additional undeveloped land for expansion or approach protection, how local land use planning and zoning actions would foster the airport's fulfillment of that need.

When a master plan has been adopted for an airport, the local agency's analysis should focus on the relationship between the proposed local action and the airport's plan. In instances where a master plan for the airport does not exist (or was never adopted), the ALUC is required to have obtained Caltrans Division of Aeronautics approval to use an airport layout plan as the basis for preparation of the commission's compatibility plan. Under those circumstances, the state-approved plan should be the basis for the local agency's analysis.

- **Relationship to California Airport Noise Standards** — The state airport noise standards are set forth in Title 21 of the California Administrative Code. These standards are "designed to cause the airport proprietor, aircraft operator, local governments, pilots, and the [Department of Transportation] to work cooperatively to diminish noise problems."

  In addressing the question of consistency of the proposed action with the state noise standards, the local agency should refer specifically to the content of the noise element of its own general plan. Section 65302(g) of the Government Code requires community general plans to include a noise element. This element is required to describe the community noise environment in terms of both near and long-term noise exposure contours for various noise sources. Airports are among the noise sources that should be considered in the noise element. The findings should:

  - Document any inconsistencies between noise element policies and noise compatibility criteria in the ALUC compatibility plan and attempt to resolve why the differences exist;
  - Show how noise element policies will assure conformance with the state noise airport standards; and
  - Identify any measures to be incorporated into local development to mitigate existing and foreseeable airport noise problems.

- **Preventing Creation of New Noise and Safety Problems** — The preceding item covers the topic of noise. With respect to safety, reference should be made to both the land use and the safety elements of the general plan. Aircraft accident location data and analyses presented in Chapters 8 and 9 of this *Handbook* also can provide factual support for the findings. The findings should:

  - Document any inconsistencies between the proposed land use action and safety compatibility criteria in the ALUC compatibility plan;

- Describe the measures taken to assure that risks — both to people and property on the ground and to the occupants of aircraft — associated with the land use proposal are held to a minimum; and
- Indicate that the proposed land use action falls within a level of acceptable risk considered to be a community norm.

- **Protecting Public Health, Safety, and Welfare by Ensuring Orderly Expansion of the Airport** — This purpose is essentially the same as the first one listed above.

- **Minimizing the Public's Exposure to Excessive Noise and Safety Hazards** — Key words in this component of the law's purpose are *minimize* and *excessive*. The phrase "to the extent such areas are not already devoted to incompatible uses" is significant as well.

  The language used in the statute implies a quantitative assessment of noise exposure and safety hazards that should be conducted by the airport land use commission and local city or county. The purpose of the statute is not merely to *reduce* the public's exposure to noise and safety hazards, but to *minimize* exposure in areas with *excessive* noise or safety concerns. To adopt a finding demonstrating consistency with this purpose, the local agency first must determine whether the existing noise exposure or safety hazards are *excessive*.

  - If existing noise and safety hazards are not excessive, then the actions taken by the local agency must "prevent the creation of new noise and safety problems" to be consistent with the purposes of the statute (see the third bullet above).
  - If the existing exposure is excessive, the local agency would have to show how its action in overriding an ALUC determination of inconsistency nonetheless *minimizes* additional exposure to those noise and safety concerns that have been identified.
  - Finally, the local agency needs to show the extent to which land uses in the area in question are already incompatible with airport operations, and how an action to override would not create a new incompatible use, or would not expose additional persons or property to noise and safety hazards associated with existing compatible uses.

Implications of Local Agency Override

The state law indicates several implications of a local agency's decision to override an ALUC determination:

- **Action Approved** — The most obvious outcome of a local agency's override is that the proposed action — approval of a plan, ordinance, project, or whatever — takes effect just as if the ALUC had approved it or found it consistent with the compatibility plan.

- **Subsequent Reviews** — ALUC review of individual development projects — except those requiring a general plan, specific plan, or zoning ordinance amendment — becomes voluntary after a local agency adopts a general plan or specific plan for the airport area whether by making it consistent with the compatibility plan or through an override action (Section 21676.5(b)).

It is perhaps of significance to note that the immunity provision of the state law has not been tested in court. Its validity is held by some to be doubtful.

- **Airport Proprietor's Immunity** — Two sections of the law establish that, if a city or county overrides an airport land use commission with respect to a publicly owned airport not operated by that city or county, the agency operating the airport "shall be immune from liability for damages to property or personal injury caused by or resulting directly or indirectly from the public agency's decision to override the commission's action or recommendation" (Sections 21678 and, with slightly different wording, 21675.1(f)). The law does not indicate who will become liable under these circumstances.

- **Lack of Notification to ALUC** — Another common result of an override decision is the lack of notification to the ALUC. From the perspective of ALUCs and airport managers, one of the significant shortcomings of the state law is that it does not require a local agency to notify the commission of a pending override action. Frequently, the ALUC and its staff do not become aware that an override has occurred until after the fact, if at all. Giving the commission an opportunity to state its case at a public hearing and challenge unsupported findings would potentially avoid some of the resulting incompatibilities and would further the objectives of the statutes.

ROLE OF AIRPORT PROPRIETORS

Apart from their obligation to submit airport master plans, construction plans of new airports, and plans for airport expansion (when an amended airport permit is required) for airport land use commission review, airport proprietors also have a more basic role in airport land use compatibility matters. There are three facets to this role. One arises because of the relationship between the airport proprietor's actions and the substance of the ALUC compatibility plan for the airport. A second is the airport proprietor's direct responsibility for fostering compatibility between the airport and its environs. Lastly, airport proprietors have a community relations role which can have implications on land use compatibility issues.

Influence on ALUC Compatibility Plan

By law, an airport land use commission cannot establish policies governing the operation of any airport. Nevertheless, because an ALUC's compatibility plan for an airport must be based upon the long-range plans for that airport, the manner in which the airport is or will be constructed and operated clearly has a major bearing on the compatibility plan. The airport's ability to affect the location and magnitude of airport impacts can make development compatible in places where it would otherwise not be acceptable.

Some examples of this relationship are obvious. The configuration of the existing and proposed airport runways is a major determinant of noise and safety compatibility zone locations. Other influences on the compatibility plan are usually more subtle and may or may not be taken into account in the ALUC's formulation of the compatibility plan. As mentioned in Chapter 3, one airport operational procedure which can have an important influence on a compatibility plan is the location of traffic patterns. If a traffic pattern exists only on one side of a runway, whether for compatibility purposes or other reasons, fewer restrictions on land uses may be necessary on the non-traffic-pattern side.

Actions to Enhance Land Use Compatibility

Most airport proprietors understand that they too have a responsibility for promoting airport land use compatibility. They cannot rely solely upon actions taken by the airport land use commission or the agency having jurisdiction over local land uses.

Land use compatibility actions available to airport proprietors fall into two basic categories:

- Measures to limit the airport's impacts; and
- Actions to protect against incompatible land uses.

Limiting the Airport's Impacts

One of the functions of an airport master plan is to identify measures which the airport proprietor can take to limit the noise and safety impacts generated by airport activity. Identified measures must then be assessed to determine whether the benefits to be gained by the community would outweigh the costs that would be incurred either by the airport itself or by aircraft operators. At busy airports where these issues are particularly complex, FAA-funded studies under Part 150 of the Federal Aviation Regulations, *Airport Noise Compatibility Planning*, are sometimes conducted.

The specific actions listed here are intended only as examples and are in no way meant to suggest that they should be implemented at a given airport. None of these measures may be necessary at airports with few compatibility problems. Even at airports with extensive noise and/or safety impacts, many of the listed measures may not be appropriate.

Actions directly available to airport proprietors can be divided into three general groupings as noted below.

- **Modification of Airport Facilities** — Physical modification of airport facilities can sometimes move airport impacts away from the most populated or noise-sensitive areas or else buffer those areas from the impacts. Implementation of these modifications typically requires Federal Aviation Administration review, approval, and funding. Among the specific examples are:
  - Displace the location of a runway landing threshold.
  - Increase the approach slope angle for instrument or visual approaches.
  - Construct a secondary runway to separate small, slow airplanes from private or commercial jets.
  - Move the location of the pre-flight run-up area away from the end of the runway or construct a noise barrier around it.
  - Establish an engine testing and maintenance site away from noise-sensitive areas and enclosed by a noise barrier.
  - Construct a helicopter training helipad either in a remote corner of the airport or at a separate site in an unpopulated location away from the airport.
- **Controls on Airport Capacity** — Airport capacity controls are usually set by policies of the local agency which owns the airport. These controls can take several forms:
  - Limit (by removing or not constructing) the number of spaces available for parking aircraft.
  - Avoid improvements which would increase runway capacity.
  - Establish an airport access plan limiting the volume of airline aircraft operations.
  - Establish a maximum cumulative noise level which, when reached, would trigger aircraft operational restrictions.
- **Restrictions on Individual Aircraft Operations** — The most wide-ranging set of impact-limiting measures are ones which restrict the types of aircraft operations or dictate where or when they occur. The cooperation of pilots is essential to the success of these measures. Also, the majority require Federal Aviation Administration approval and cooperation for implementation, especially at a tower-controlled airport. Depending upon the circumstances, some of measures listed might even be opposed by the FAA.
  - Designate a preferential noise-abatement runway or runways, particularly for departures.

- Designate a preferred touch-and-go training runway.
- Limit the traffic pattern location to a single side of the runway.
- Increase the traffic pattern altitude.
- Restrict departure turns until aircraft have passed a specified point or reached a certain altitude.
- Modify instrument approach or departure procedures.
- Establish helicopter approach and departure routes.
- Limit or prohibit touch-and-go operations.
- Prohibit intersection departures.
- Restrict or prohibit nighttime aircraft operations.
- Restrict or prohibit the operation of noisy aircraft based upon their certified (FAR Part 36) or actual monitored noise levels.
- Establish landing fees for aircraft based upon the amount of noise they create.
- Establish limits on the weight of aircraft permitted to use the airport.
- Recommend and encourage pilot use of aircraft operational techniques which minimize noise levels.
- Restrict where or when engine run-ups for maintenance and testing purposes can be conducted.

Protecting Against Incompatible Land Uses

The other category of airport land use compatibility actions which an airport proprietor can and, whenever practical, should undertake is to directly control the property most critical to compatibility. In most instances, this means acquiring the property. The acquisition can be outright, fee simple title acquisition or the acquisition of an easement granting specified rights to the airport.

From the airport's perspective, the chief advantage of property acquisition is to provide long-term assurance of land use compatibility. If the airport owns the property or an easement, maintenance of compatibility is not dependent upon the success of ALUC actions or the understanding and cooperation of the local jurisdiction having land use powers. There are also disadvantages, however; cost being the major one.

Airport property ownership is most critical for the runway protection zones. Ideally, these areas immediately beyond the runway ends should be clear of structures and be used only for agricultural or other low-intensity use. As discussed in Chapter 3, airport land use commissions are

Among the assurances that an airport proprietor must give to the FAA before receiving a project grant is to take appropriate action "to restrict the use of land adjacent to or in the immediate vicinity of the airport to activities and purposes compatible with normal airport operations." When the agency owning the airport also has jurisdiction over surrounding land uses, zoning may suffice, especially for lands outside the runway protection zones. However, when the jurisdictions are different or where unprotected land is within a runway protection zone, direct acquisition may be the only effective means of carrying out the grant assurances.

patible land uses. New residential development would be excluded.

Because the rights to ownership and limited use of the property remain with the landowner, the cost of acquiring approach protection easements is usually less than that of fee title. Airports can obtain approach protection easements either through direct acquisition or, when necessary, by acquiring fee title then reselling the property while retaining the easement.

Community Relations

Among the most effective means airports have available with which to minimize airport/community conflicts is to reach out to local residents by means of a community communication program. Generally, the more informed that people are about an airport and its activities, the less likely they are to complain about it. Possible elements of a communication program might include:

- Creation of a telephone hot line.
- Periodic publication of a newsletter about the airport.
- Talks to local civic groups.
- Offering tours of the airport.
- Establishment of an airport/community advisory committee.

Additionally, a real estate disclosure program could be implemented, at least in an informal manner, by the airport proprietor. An airport cannot, on its own, include such a program as part of an overlay zoning ordinance affecting surrounding land use jurisdictions. Nevertheless, airport proprietors can assemble information about the airport, its activity levels and traffic patterns, and any other factors which may influence land use compatibility. This information could then be distributed to local real estate agents and be made available to airport area residents.

Part II

Airport Land Use Compatibility Issues

Chapter 6

Characteristics of Noise

6

Characteristics of Noise

OVERVIEW

This chapter examines the basic characteristics of noise as it relates to airports. The discussion covers:

- The physical properties of sound;
- The measurement of environmental noise;
- The nature of airport noise; and
- The effects of noise on people.

The chapter which follows addresses the land use compatibility planning implications created by airport noise.

By one common definition, noise is simply *unwanted* sound. Sound is something which can be precisely defined and physically measured. Noise, on the other hand, is highly subjective. Sounds which may be pleasant and desirable to one person may be noise to someone else. Moreover, even when people agree that a sound constitutes noise, their reactions to that noise may vary substantially.

It is this variability which makes the study of noise so complex. Over the last three or four decades, a substantial amount of research has been done, particularly in the United States and Europe, assessing how people react to noise. Much of this research has been specifically concerned with aircraft noise exposure. Within the last decade, considerable debate has arisen over both how best to measure this noise and how to assess the significance of the measurements.

A federal government report, completed in 1992, has been at the center of much of the recent debate. The express purpose of that report — prepared by the Federal Interagency Committee on Noise (FICON) — was to review federal policies that govern the assessment of airport noise impacts. The FICON proposed certain changes to established noise assessment practices, but, for the most part, supported methodologies which have been in use for some time. Regardless of whether one fully supports the FICON's conclusions and recommendations, the report's technical section is valuable for its comprehensive summary of the issues involved in measuring noise and assessing its effects on people.

The present *Airport Land Use Planning Handbook* does not contain any new, original research on the subject of noise. Rather, its intent is to summarize current information on the topic, particularly as it pertains to airport land use compatibility planning. The material presented here relies heavily upon the FICON report and other recent literature on airport noise issues.

PHYSICAL PROPERTIES OF SOUND

Sound is transmitted in the form of pressure waves. These waves are created by oscillation of particles of air – that is, air particles being displaced from and returning to an equilibrium position. As the particles are displaced, they bump into surrounding particles which bump into others and so on. In this manner, sound is transmitted through the atmosphere. Sounds are heard when the pressure waves of displaced air particles strike the eardrum, causing it to vibrate.

Measurement of Sound

A tabulation of approximate decibel levels generated by common indoor and outdoor sound sources is presented in Table 6A.

The physical properties of a sound can be measured in terms of three basic components: *magnitude*, *frequency*, and *duration*. Although these components can be directly measured, useful measures of sound are complicated both by environmental variables and the way in which people hear sound.

Magnitude

The magnitude or strength of a sound is determined by how much the air particles are displaced from equilibrium by the sound pressure waves. The greater the amplitude of the pressure fluctuation, the more acoustic energy the sound wave carries. Simply measuring the magnitude of sound on a linear scale is not practical, however, because the range of sound pressures which the human ear can detect is enormous – a ratio of 1 to approximately 10^{14} (1 followed by 14 zeros). By converting this ratio to a logarithmic scale, the range can be reduced to 14 units. The unit of sound level measurement on this scale is the *bel* (in honor of Alexander Graham Bell). Normally, though, these units are divided into tenths – that is, *decibels*. The range of human hearing thus extends from 0 decibels, corresponding to the faintest sound level that the healthy, unimpaired human ear can detect, to more than 140 decibels. (Sound levels of nearly 200 decibels are possible – such as inside a rocket engine – but are greater than the unprotected human ear can withstand.)

The use of a logarithmic scale for measurement of the magnitude of sound is often the cause for confusion because it does not directly correspond to the way in which people perceive the relative *loudness* of different sound levels. People tend to think that, if two equal sounds are combined, the result will seem twice as loud. In reality, however, combining two equal sounds – although it doubles the sound energy – produces only a 3 dB increase in magnitude. For one sound to be judged twice as loud as another, it actually must be 10 dB higher (meaning that the acoustic energy must increase 10-fold). Also confusing is that

INDOORS	A-weighted Decibels	Tolerance	OUTDOORS
	140	Threshold of Pain	
	130		Pneumatic Riveter Military Jet takeoff with after-burner at 50 feet
Oxygen Torch	120	Uncomfortably Loud	
Rock and Roll Band	110		Jet takeoff at 1,000 feet
			Jet flyover at 1,000 feet
Inside Subway Train (New York)	100	Very Loud	
Newspaper Press			Farm Tractor at 50 feet Power Mower at 3 feet
	90		Motorcycle at 50 feet
Food Blender at 3 feet			Diesel Truck at 50 feet
Garbage Disposal at 3 feet Shouting at 3 feet	80		Noisy Urban Daytime Auto 65 mph at 50 feet
		Moderately Loud	Light Airplane at 1,000 feet
Vacuum Cleaner at 10 feet	70		Power Mower at 100 feet
Normal Speech at 3 feet Electric Typewriter at 10 feet			Commercial Area Auto 30 mph at 50 feet
Conversation Background Music Large Business Office	60		Air Conditioner at 50 feet
Dishwasher, Next Room	50	Quiet	Light Traffic at 100 feet Quiet Urban Daytime
Very Quiet Radio at Home	40		Quiet Urban Nighttime
Library			Quiet Suburban Nighttime
	30		Quiet Rural Nighttime
Concert Hall (background) Broadcasting Studio		Very Quiet	
	20		
	10	Barely Audible	Leaves Rustling

Source: Compiled by Hodges & Shutt from various sources (December 1993)

Table 6A

Approximate Sound Level of Common Sound Sources

this relationship of 10 dB per doubling of loudness applies to any 10 dB increase — sound level increases from 40 dB to 50 dB or from 80 dB to 90 dB are both perceived as representing a doubling of loudness.

Frequency

The frequency of a sound — its *tonal quality* — depends upon the relative rapidity of the air pressure oscillation. In a low-pitched tone, the sound waves are relatively far apart (that is, the wavelength is relatively long), while in a high-pitched tone they are squeezed much closer together. Frequency is measured in cycles per second (also called *hertz* or Hz). Although some *pure* tone sounds contain only one frequency, more often sound is a mixture of different frequencies.

The response of the human ear to different sounds is significantly affected by the frequency of those sounds. Although people can hear sound frequencies as low as 20 hz and as high as 20,000 hz, they do not hear all frequencies in this range equally well. Very low and very high frequency sounds are perceived to be less loud than mid-range sounds. Most environmental sound measurements consequently are weighted to simulate the varying frequency sensitivity of the human ear. A widely used weighting for general environmental sounds (as opposed to large-amplitude impulse sounds such as sonic booms) is the A-weighted sound level expressed in decibels (sometimes abbreviated dBA).

Duration

The third component of sound is the length of time over which it occurs. Many sounds have a distinct beginning and ending; others, such as from aircraft overflights, gradually increase and decrease without a sharp definition of when they start or stop. In the latter case, the duration of the sound is usually measured in terms of the time period over which the sound level exceeds a specified threshold.

Because sound levels vary from one moment to the next, it is not possible to say that a given noise was "so many decibels" except when referring to an instantaneous measurement or by averaging the sound level over time. As discussed below under the heading of *Measuring Environmental Noise*, numerous methods have been developed which seek to measure the overall *exposure* produced by a noise event or events within a defined period of time.

Sound Attenuation

Sound Attenuation in the Outdoor Environment

Among the basic characteristics of sound which are of particular interest in the discussion of aircraft-generated noise are sound attenuation or reduction over distance. Part of the reduction occurs because sound energy is spread over a three-dimensional, geometrically increasing area as the distance from the source increases. At sufficient distances from the source, geometric spreading alone results in a 6 dB loss per doubling of distance. Actual attenuation of sound is greater than this as a result of factors such as absorption by the atmosphere. Also, atmospheric attenuation is greater for high-frequency sound than for sound with a low frequency.

Other factors also influence the extent to which sound is attenuated in the environment. Sound propagation through the air is affected by meteorological conditions including air temperature, temperature inversions, humidity, wind speed, and air turbulence. Sound travelling along a hard ground surface is attenuated by approximately an additional 2.5 dB in 1,000 feet (compared to the attenuation in air alone) and tall grasses or shrubs can double this figure. Structures, terrain, or other barriers can provide significant attenuation for ground-to-ground sound as well. Ground cover and objects on the ground, however, have little effect on reducing air-to-ground sound such as that from aircraft. Moreover, buildings and other such objects can cause reflections which may even *increase* the localized sound level.

Sound Attenuation Provided by Buildings

For indoor activities, another significant factor affecting the level of aircraft-generated noise to which people are exposed is the amount of sound attenuation provided by the building. Several different metrics have been developed for use in measuring the sound insulation capabilities of buildings.

One metric commonly associated with the individual structural components of a building is the *Sound Transmission Class* (STC). The STC rating of a component is expressed as a single number, in decibels, and is calculated in laboratory testing of the component. STC ratings are often used in construction specifications to indicate a required sound insulation capability. The original application of STC ratings was with regard to interior partitions, but it can also give some indication of the sound attenuation provided by exterior walls, windows, and doors.

Caution must be used, however, when attempting to evaluate the exterior-to-interior sound level attenuation of a building by means of STC ratings. First, as a single number, the STC of a structural component may not adequately reflect differences in the component's relative abilities to block sounds of different frequencies. Secondly, the overall sound attenuation provided by most buildings cannot be calculated from STC ratings. The various components of a building each have different noise insulation qualities. Moreover, sound tends to enter an interior space not so much through individual components but by way of openings and gaps such as vents, door jambs, and so forth. Interior noise levels from exterior sources thus are substantially determined by the weak link in the overall construction.

A more general measure of a building's sound attenuation attributes is its *Noise Level Reduction* (NLR). Like STC, NLR is a single-number value measured in decibels and as such may disguise a building's varying response to different sound frequencies. Unlike STC, though, NLR is measured in field testing of actual structures. It thus takes into account the fact that buildings are made up of numerous components.

Table 6B is offered here as a very general guide to the overall Noise Level Reduction afforded by average types of building construction.

State airport land use commission statutes (Public Utilities Code, Section 21675(a)) specifically note that ALUCs may "determine building standards, including soundproofing" when developing airport land use compatibility plans. ALUCs have mostly steered clear of setting detailed building standards, however. Those that deal with the question of acceptable indoor noise levels typically use one of two approaches. One method is to indicate the noise level standards for various indoor building uses and require project proponents to show how those standards will be met. Another common approach is for the ALUC to establish criteria specifying the amount of Noise Level Reduction a building in a particular noise environment must provide. Again, the details of how the criterion is met are left to the proponent.

MEASURING ENVIRONMENTAL NOISE

Measurement of sound is a relatively straight-forward and objective process. Environmental noise, however, is comprised of a multitude of varying sounds having different magnitudes, frequencies, and durations, and stemming from different sources. Moreover, to be useful, measures of environmental noise must take into account the ways in which noise affects people.

The latter topic is discussed in the final section of this chapter. The subject here is the variety of metrics employed in the measurement of noise. Noise metrics can be grouped according to whether they measure the sound level of a single event or are cumulative measures of many events. Each of these metrics has notable advantages and disadvantages which vary depending upon the purpose of the noise measurement.

Construction Type	Typical Occupancy	General Description	Noise Level Reduction (NLR) in dB
1	Residential, Commercial, Schools	Wood framing. Exterior stucco or wood sheathing. Interior drywall or plaster. Sliding glass windows. Windows partially open.	15-20
2	Same as 1 above	Same as 1 above, but windows closed.	25-30
3	Commercial, Schools	Same as 1 above, but windows are fixed 1/4-inch plate glass.	30-35
4	Commercial	Steel or concrete framing. Curtain-wall or masonry exterior wall. Fixed 1/4-inch plate glass windows.	30-40

Notes:

- Construction methods assume no special control provisions.
- The NLR range depends upon the openness of the windows, the degree of seal, and the window area involved.
- Buildings constructed to meet 1990s standards for energy efficiency may slightly increase the NLR values indicated above.

Source: Paul S. Veneklasen & Associates (1973)
Supplemental notes, Hodges & Shutt (December 1993)

Table 6B

Noise Reduction Afforded by Common Building Construction

Single-Event Metrics

As noted earlier, the sound level associated with an individual aircraft flying nearby can be characterized as:

- Beginning at some point when the sound can be distinguished above the background sound level;
- Reaching a maximum level; then
- Diminishing until it is no longer distinct.

Instantaneous Sound Levels

Sound levels can be measured on a continuous basis for each instant during this cycle. The most significant point, though, is the maximum level attained (L_{max}). The measurement scale is in decibels.

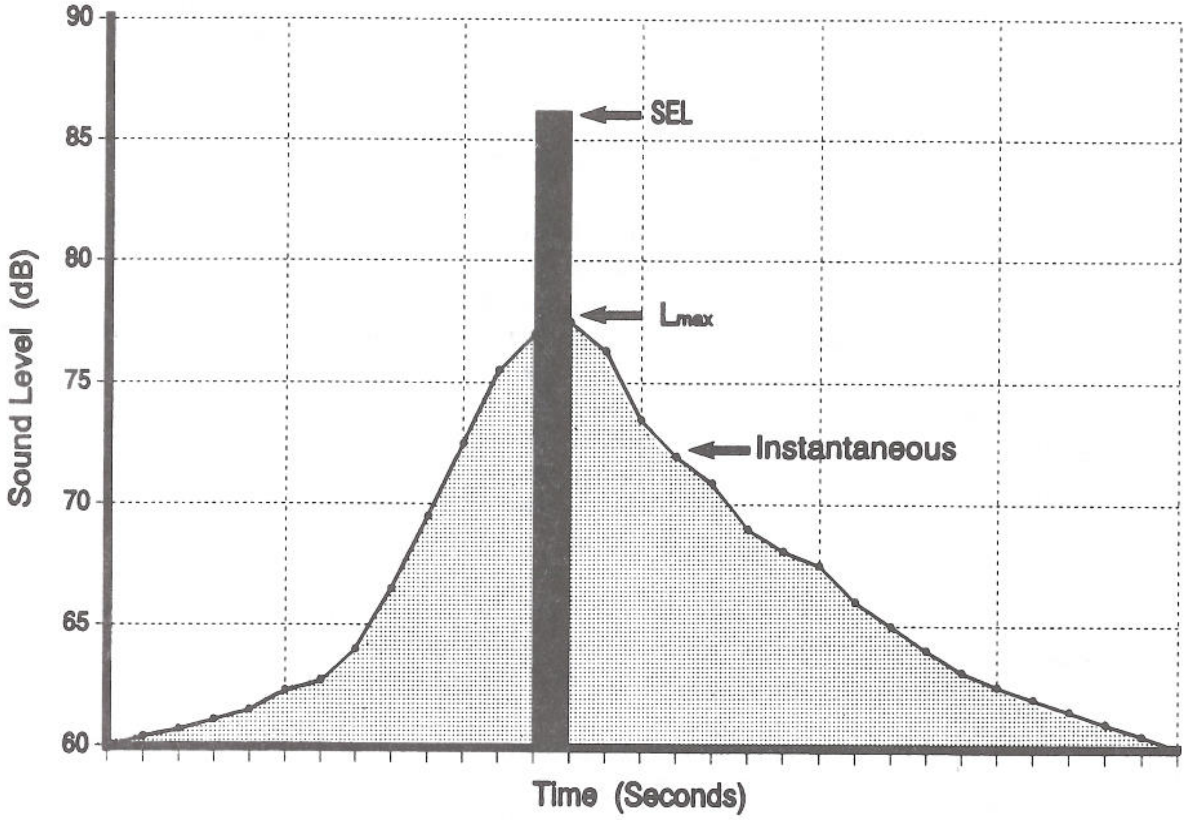
Single Event Energy

The limitation of an instantaneous sound level measurement is that it provides no information regarding the duration of the sound. Two different aircraft overflights thus can produce vastly different total amounts of sound energy depending upon how quickly the aircraft pass by. To compare the total sound produced by individual aircraft flyovers, a reference time of one second is used. In other words, this measurement method indicates the level of a continuous one-second sound which contains the same amount of energy as the complete noise event. The resulting noise metric is called the *Sound Exposure Level* (SEL) or *Single Event Noise Exposure Level* (SENEL). (The latter term is used in California, the former is adopted by the U.S. Environmental Protection Agency and the Federal Aviation Administration. SEL and SENEL values are virtually identical.)

Figure 6A illustrates the relationship between L_{max} and SEL or SENEL for a typical aircraft noise event. Because aircraft noise events last more than one second, SEL/SENEL values are higher than the L_{max} recorded for any individual event. The relationship between SEL/SENEL and L_{max} is not constant, however. For most aircraft noise events, SEL/SENEL is about 5 to 10 dB higher than L_{max}; the shorter the noise event is, the closer the two numbers will be.

Cumulative Noise Metrics

In order to provide a single measure of continuous or multiple noise events over an extended period of time, a variety of cumulative or average noise level metrics or descriptors have been devised.



Source: Hodges & Shutt (December 1993)

Figure 6A

Typical Aircraft Noise Event

Equivalent Sound Level

A standard measure of sound level averaged over a specified period of time is the *Equivalent Sound Level* (abbreviated L_{eq}). This metric indicates the constant sound level in decibels which would produce the same amount of sound energy as a series of events having fluctuating sound levels. The more closely spaced the noise events over the entire measurement period, the closer L_{eq} will come to L_{max}. This is the case for noise from a busy highway, for example. For infrequent noise events, such as at a low-activity general aviation airport, L_{eq} may not be much higher than the ambient noise level.

Time-Weighted Cumulative Noise Metrics

Because the DNL and CNEL scales are logarithmic, a 10 dB penalty on a single event is actually calculated as if the event occurs 10 times. In CNEL calculations, evening events are each counted 3 times, which means that the precise penalty is 4.77 dB.

These types of metrics include the *Community Noise Equivalent Level* (CNEL) used in California and the *Day-Night Average Sound Level* (abbreviated DNL or L_{dn}) adopted by the Environmental Protection Agency and the Federal Aviation Administration and used elsewhere in the United States. Both are similar to the Equivalent Sound Level (L_{eq}) except that they compensate for the widely assumed increase in people's sensitivity to noise during nighttime hours. Each adds a 10 dB penalty to events which occur between 10:00 p.m. and 7:00 a.m. CNEL also includes an approximately 5 dB weighting for evening (7:00 to 10:00 p.m.) noise events.

These figures correspond to the drop in background noise level which studies have found takes place from daytime to evening and nighttime in a typical community. The evening and nighttime decrease in ambient sound levels — from both outdoor and indoor sources — is commonly considered to be the principal explanation for people's heightened sensitivity to noises during these periods.

CNEL Noise Contour Calculation Inputs

- The number of operations by aircraft type or group.
- The distribution of operations by time of day for each type of aircraft.
- The average takeoff profile and standard approach slope used by each aircraft type.
- Runway system configuration and runway lengths.
- Runway utilization distribution by aircraft type and time of day.
- The geometry of common aircraft flight tracks.
- The distribution of operations for each flight track.

DNL and CNEL values are normally depicted by a series of contours representing points of equal noise exposure in 5 dB increments (see examples in Appendix C). Mostly, the contour calculations are done by a Federal Aviation Administration computer program — the *Integrated Noise Model* (INM). The standard user inputs to the contour calculations include the factors listed to the left. In addition, built into the model's database are:

- Standardized data regarding performance characteristics of some 100 different types of airplanes (INM database 10);
- The power settings used by each aircraft type at various stages of landing or takeoff; and
- The amount of noise measured at various distances for each power setting.

The database reflects average operating conditions for each aircraft type. In most cases this data is used directly when calculating noise contours. However, the model also has the capability of accepting user input data to better fit known variations for a particular aircraft or airport.

Note: A new update of the INM computer program (version 4.11) has recently become available. This upgrade includes several enhancements to the model's core equations. Additionally, a major revision (version 5.0) to the INM program is expected to be released by the FAA late in 1994. It is anticipated that this new version will significantly simplify the process of calculating noise contours.

For calculation of noise contours at heliports, the FAA has developed a separate program — the *Helicopter Noise Model* (HNM). This model includes data for 16 types of helicopters. However, its lack of static mode flight data for most of the helicopters in the database limits HNM's usefulness in modeling hover noise levels which are critical to evaluation of noise exposures close to heliports and helipads. Also, HNM does not allow user modifications to the database.

An update of HNM scheduled for release early in 1994 may remedy some of these shortcomings. Also, an alternative method of modeling helicopter noise levels is to use the U.S. Air Force NOISEMAP model. This model was specifically developed for military aircraft, but includes helicopters similar to civilian models.

Several other factors affecting the computation and use of cumulative noise exposure metrics are important to note:

- **Effect of Occasional Loud Events** — A relatively few operations by aircraft which generate noise levels well above the average for the airport can greatly influence the size of the noise contours. This is particularly true if these operations occur at night or at airports with low volumes of activity.

Figure 6B depicts the relationships between the number of noise events, their loudness (in SEL), and the resulting DNL.

- **Effect of Frequency of Operations** — If the distribution of operations by aircraft type, time of day, and so on is held constant, a doubling of the number of operations will increase the DNL/CNEL values by 3 dB. The small size of this change is a result of the logarithmic scale upon which the decibel unit is measured.

- **Seasonal Variations** — DNL and CNEL values are usually calculated in terms of an average day of the year. Occasionally, shorter time periods are evaluated. Shorter time frames are primarily assessed for airports which have substantial variations in operating characteristics — total volume of operations, type of aircraft, or patterns of runway use — from one season to another. Seasonal variations in noise exposure can be particularly significant at airports where the highest activity levels occur in the summer when outdoor residential living and open windows in dwellings are most common.

- **Flight Track Locations** — General aviation flight track locations vary widely and determining the location of the predominant tracks is difficult. Also, the Integrated Noise Model computer program is limited in the number of tracks that can reasonably be modeled. By contrast, at airline airports, instrument approach and departure procedures limit the variety of flight track locations and locational data is often available from computerized flight control records.

Greater accuracy can be obtained at airports where a permanent noise monitoring system is installed.

- **Precision** — Because of the many variables and assumptions associated with their computation, cumulative noise contours are usually considered to have an accuracy of approximately ±3 dB. The accuracy is greatest close to the runway and decreases beyond where flight tracks diverge. Noise contour locations are often inappropriately used to precisely determine the acceptability or unacceptability of a particular land use at a specific site without appreciation of the imprecision of the noise contour locations.

Other Cumulative Noise Metrics

Two other types of cumulative noise metrics are sometimes used to measure environmental noise.

- **Level Exceeded** — This metric evaluates the amount of time over which each noise level occurs, then indicates the level exceeded a given percentage of time. For example, L_{10} and L_{50} are the noise levels exceeded 10% and 50% of the time, respectively. Typically, Level Exceeded measures are calculated for short time periods — 24 hours or less. The Level Exceeded metric is one of the primary noise metrics employed in analysis of relatively continuous noise, such as from a highway. It is seldom used for airport-related noise.

The Time Above metric is also sometimes used as a single-event metric to calculate the number of seconds during which the noise level of the event exceeds a specified threshold.

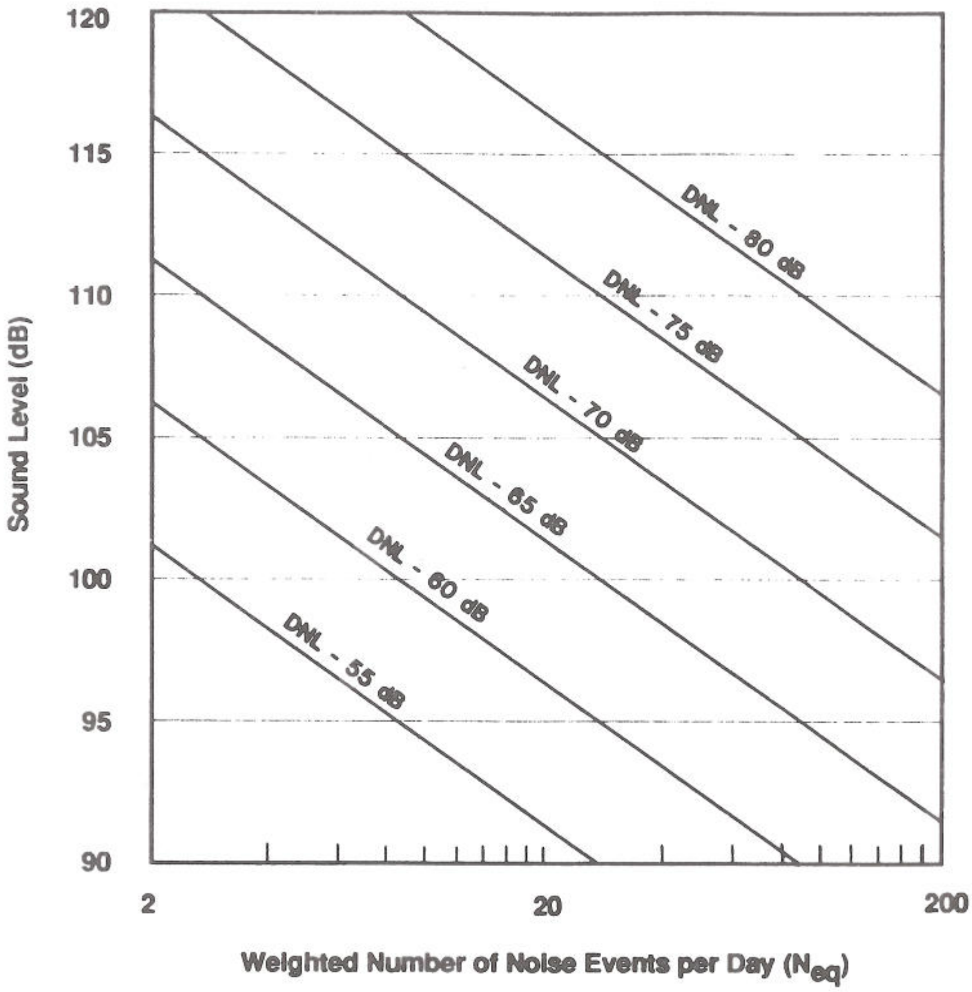
- **Time Above** — Unlike all of the preceding noise metrics which provide a noise level measurement in decibels for a specified time duration, the Time Above metric measures the amount of time a given noise level is exceeded. Typically, the measurements are stated as a number of minutes relative to an average day and are depicted for a grid of points within an airport vicinity. Separate calculations are required for each noise level evaluated.

NATURE OF AIRPORT NOISE

Noise is often perceived to be the most significant of the adverse impacts associated with airport activity. To better understand airport noise impacts, it is important to recognize the variables involved with regard to different types of aircraft, aircraft flight routes, and other factors such as pilot techniques.

Types of Aircraft

The noise emitted by different types of aircraft has distinctly different properties. Although there are also differences among specific makes and models of aircraft within each broad group, these distinctions are generally less pronounced.



$N_{eq} = Nd + 10 * Nn$

Note: Relationship assumes all events are by the same aircraft type (or by aircraft having the same sound exposure level)

Source: Brown-Buntin Associates (1992)

Figure 6B

Relationship Between DNL and Sound Exposure Level

Jet Airplanes

Both the character and the sound level (magnitude) of jet airplane noise has changed over time as new engine technologies have been developed and introduced into the airline and business jet aircraft fleets. The old, pure-jet engines produce noise that is both very loud and at the high end of the frequency spectrum. Newer generation, fan-jet engines – in which a substantial volume of the air entering the engine bypasses the combustion chamber – create noise that is comparatively lower both in magnitude and frequency. Even among fan-jet engines, noise levels have been considerably reduced with the most recent models compared to the earliest types.

The extent to which future technology can continue to reduce jet-engine noise is uncertain. Most of the overall noise level improvements which have been experienced in recent years at airports having jet activity has resulted from retirement of the older, louder jet aircraft. By the year 2000, the so-called Stage II, older-model fan-jet aircraft are to be phased out of the nation's airline fleet in accordance with federal law. If the noise level of individual aircraft remains about the same in subsequent years, the potential thus exists for the overall noise level at airports to increase along with growth in the number of aircraft operations.

Propeller Airplanes

The dominant noise from most propeller airplanes, whether they be driven by piston or turbine engines, is from the propeller itself. Propeller airplane noise varies depending upon the number of engines, the rotational speed of the propellers, the number of blades on each propeller, and the pitch of the blades, as well as, to some extent, the type of engine.

Compared to jets, the majority of propeller airplanes emit significantly less noise when measured at equal distances from the aircraft. The size of the aircraft is a major factor in this distinction, however – most propeller airplanes flying today are substantially smaller and lighter than jets airplanes are. For aircraft of similar weight, the noise levels of aircraft that are propeller driven and those that have new-technology, fan-jet engines are not greatly different. Another factor affecting the relative noise levels generated by the two aircraft types is the takeoff climb profile. Because jets climb much more rapidly than typical propeller airplanes, the noise levels measured on the ground diminish rapidly with increased distance from the runway. Consequently, at points sufficiently far from the runway end, the higher altitude attained by jets may make them effectively quieter than propeller airplanes.

Helicopters

Figure 6C depicts the normal sound level range of helicopter operations, measured at a distance of 250 feet.

Helicopter noise has a character all its own. Although a portion of the noise emanates from the engines themselves, the uniqueness of helicopter noise is mostly due to the modulation of sound created by the relatively slow-turning main rotor. This sound modulation is referred to as *blade slap*. Blade slap is most pronounced during low-speed descents and high-speed cruise. To a listener on the ground, it is most audible as the aircraft approaches. Helicopters are also notable for creating vibration or rattle in structures.

Aircraft Flight Routes

In general, the most significant noise impacts created by aircraft are concentrated near the ends of airport runways. The locations of aircraft flight routes to, from, and around an airport, however, are also a major determinant of where noise impacts occur on the ground below.

Several factors define where the flight routes at a particular airport are flown. The most fundamental factor is the distinction between visual and instrument procedures. Also, different types of aircraft typically fly different flight patterns. Lastly, flight route locations are often affected by the peculiarities of an airport's layout, airspace configuration, and surrounding terrain and land uses.

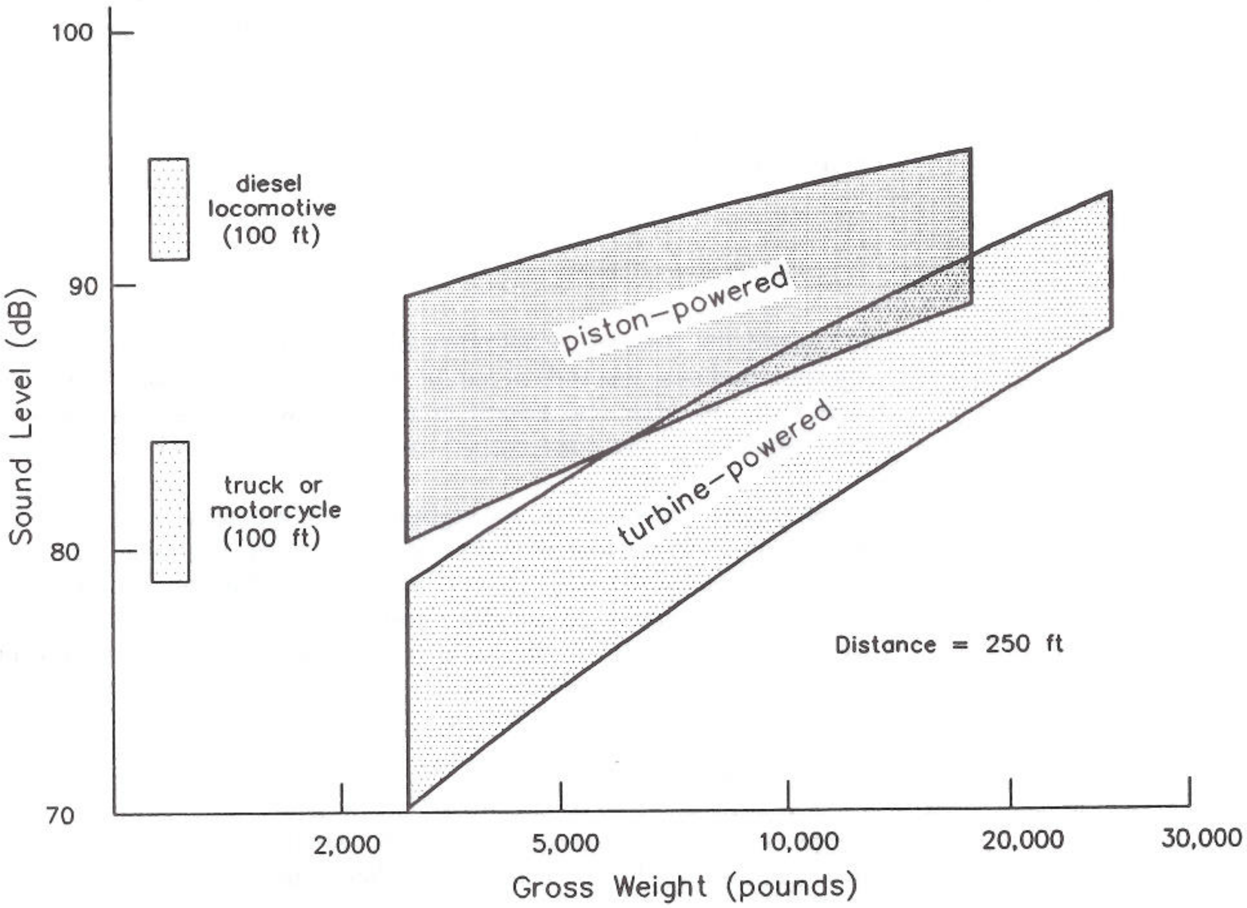
Types of Flight Rules

Aircraft fly to and from airports under two different sets of operating procedures defined by Federal Aviation Regulations:

- **Visual Flight Rules (VFR)** — VFR operating procedures apply at airports when weather conditions (i.e., the horizontal visibility and the cloud ceiling height) permit pilots sufficient time to see a runway for landing as well as to see and avoid other aircraft in flight and obstacles on the ground. These minimums are set by Federal Aviation Regulations Part 91. Within controlled airspace around airports the minimum visibility requirement for VFR flight is 3 statute miles.

- **Instrument Flight Rules (IFR)** — IFR procedures are required when the weather conditions are below the minimums for VFR operations. Under IFR procedures, pilots must rely on the aircraft's cockpit instrumentation, ground-based navigational aids, and (where available) air traffic control services.

A mixture of VFR and IFR procedures are frequently used for aircraft operations at airports. IFR procedures can be followed during VFR conditions. This is the standard practice for airline aircraft and also occurs



Source: Helicopter Association International (1991)

Figure 6C

Helicopter Noise Levels

during instrument flight training. Additionally, VFR procedures are often used at the termination of an IFR flight once the pilot has the airport in sight.

Airplane Traffic Patterns

Federal Aviation Administration guidelines establish the standard traffic pattern flown by airplanes approaching and departing airports under VFR conditions. Airplane traffic patterns are defined in terms of a generalized routing and an altitude (or height above the airport). The generalized routing is in the form of a racetrack-shaped path leading to and from the runway in use (Figure 6D). Unless precluded by local conditions, a standard traffic pattern uses left-hand turns. At most airports, the traffic pattern altitude for small airplanes is 800 to 1,000 feet above the airport elevation (or sometimes higher for large aircraft).

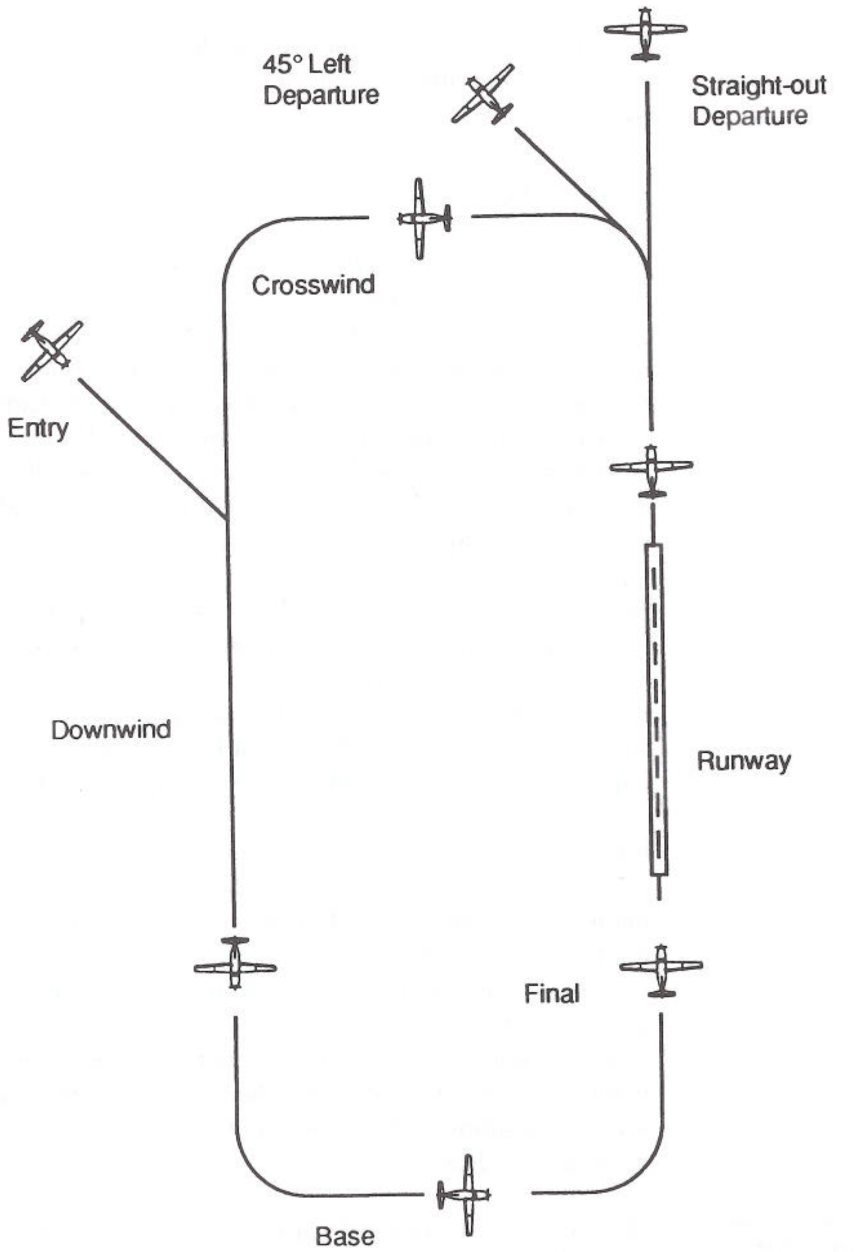
The direction of flow within a traffic pattern depends mostly upon wind conditions. When winds are moderate to strong, aircraft will almost always takeoff and land facing as closely into the wind as the choice of runway alignment permits. When winds are calm or mild, other factors such as attaining the most efficient flow of traffic or minimizing noise impacts may influence which runway direction is used.

It is important to realize that, although most pilots normally fly a standard pattern at a non-towered airport, use of such a pattern is not mandatory. Depending upon the direction from which the flight is coming, a pilot may choose to make a *base entry* or *straight in* approach to landing. Also, after takeoff, an aircraft may depart the pattern at various points. At airports where an air traffic control tower is operating, pilots often request the type of entry or departure which will be most convenient to them. Air traffic controllers normally grant the request unless traffic congestion or local procedures dictate the need for some other approach or departure course.

Figure 6E depicts the actual flight tracks at an airport having both airline and general aviation operations, recorded from FAA radar over two six-hour periods. Although certain primary traffic corridors can be seen, the significant diversity in flight track locations is also apparent. Additionally, even for aircraft following nearly identical tracks, variations will occur in the altitude of the aircraft at any given point along a track.

The existence of standard patterns tends to give people who are not pilots the impression that aircraft follow well-defined *highways in the sky*. The reality is that considerable variation occurs in how pilots fly traffic patterns. This variation is expected and normal.

- **Landings** – For landings, pilots of average single-engine airplanes fly the downwind leg anywhere from ¼ to 1 mile laterally from the runway. The base leg may extend even farther from the airport, particularly when other aircraft are in the traffic pattern. Also, there is a tendency by many pilots to fly a relatively wide pattern at airports with a long, wide runway even when no other aircraft are present. When larger and faster airplanes fly a traffic pattern, the pattern is not only typically higher, but also farther out than one flown by smaller airplanes. Often the pattern for these aircraft is so much higher and



Note: Recommended standard left-hand pattern is depicted.
Recommended standard right-hand pattern would be opposite.

Source: Hodges & Shutt (September 1993)

Source: Hodges & Shutt (December 1993)

Figure 6D

Standard Traffic Pattern

SACRAMENTO METRO AIRPORT

Actual flight tracks compiled from radar data

All Operations

March 25, 1991 / 1100L - 1700L

June 14, 1991 / 1100L - 1700L

Source: Harris Miller Miller & Hanson Inc. (1991)

Figure 6E

Plot of Actual Flight Tracks

farther away, that operationally it is as if they are making a straight-in approach.

- **Takeoffs** — On takeoff, the normal procedure for small airplanes is to fly straight ahead until reaching an altitude of at least 400 feet above the airport. Depending upon runway length, aircraft type, air temperature, and pilot technique, this altitude may be reached over the end of the runway or not until nearly a mile from the runway end. Some pilots (especially those of agricultural aircraft) begin a turn at a lower altitude. Jets and other large airplanes normally climb straight ahead until reaching an altitude of at least 1,500 feet.

Instrument Flight Procedures

Airport instrument procedures fall into two basic categories: *approach procedures* and *departure procedures*. Published procedures for individual airports are formally defined in accordance with federal guidelines and must be approved by the FAA. Airports may have one or more of each type of procedure based upon different navigational aids and applicable to different runway ends.

- **Approach Procedures** — Instrument approach procedures are classified as either *precision* or *nonprecision*.
  - A precision approach procedure provides both vertical and horizontal guidance to the aircraft. Current procedures all rely upon using navigational aids located on the airport.
  - For nonprecision approach procedures, the on-ground equipment — which may be located on or off the airport — gives only horizontal guidance. Pilots must rely upon other means (usually, other off-airport navigation aids and/or radar control) to determine when to descend to a lower altitude along the approach course.

  Precision approach procedures typically allow lower approach minimums than do nonprecision approach procedures. Precision approach procedures typically allow aircraft to land with weather conditions as low as a 200-foot cloud ceiling and a ½-mile visibility although some major airline airports have navigational aids which enable suitably equipped aircraft to land with *zero-zero* conditions. Good minimums for nonprecision approach procedures are generally double those typical of a precision approach procedure.

  Instrument approach procedures may be divided into as many as four segments: *initial*, *intermediate*, *final*, and *missed*. The initial and intermediate approach segments serve to guide the aircraft from major air routes to the airport vicinity. Once an aircraft is established on the final approach course, it generally is aligned with the runway and is at a precise altitude. Aircraft fly the final approach segment until reach-

Circle-to-land procedures can result in aircraft overflights of areas adjacent to and near the ends of runways which are seldom overflown under regular visual flight conditions. Also, these overflights may be at altitudes well below the normal traffic pattern altitude. The noise and safety implications of circle-to-land maneuvers may be worth special consideration in land use planning around airports where such procedures are common.

It is too early yet to tell what effect GPS capabilities will eventually have on airport design standards and safety concerns both on and off airport property. Nevertheless, it should be realized that, even with GPS, every runway will not become a precision instrument runway. Even if the design standards are reduced, runway length, lateral setback distances, and approach and missed approach path obstacles will still be factors in determining a runway's instrument approach potential.

ing the specified minimum altitude at which point, if the runway is visible, the aircraft either proceeds straight ahead to the runway or circles to land on another runway. The missed approach segment of the procedure is utilized if the runway is not visible when the aircraft reaches a predetermined position (indicated by navigational aids or timing) and minimum altitude (or the pilot elects to abandon the approach earlier). Missed approach procedures enable the aircraft to climb back to a safe altitude and then either wait for weather conditions to improve or proceed to another airport.

Instrument approach procedures' current reliance upon ground-based navigational aids is expected to change in the future. Navigational data will instead increasingly be provided by earth satellites. The technology closest to practical implementation is the Global Positioning System (GPS). Over the next decade, aeronautical use of GPS will likely be limited to en route navigation and to approach procedures which mirror existing ground-based system capabilities. Ultimately, GPS has the potential to allow establishment of new instrument approach procedures with lower minimums or even curved approach paths. Also, runways for which ground-based procedures are not now technically practical or cost effective may be capable of accommodating a GPS-based approach.

- **Departure Procedures** — All airports with instrument approach capabilities also have published instrument departure procedures. These procedures enable aircraft to depart an airport and climb to en route airspace. Departure procedures are usually less complex than approach procedures and often do not depend upon on-airport navigational aids. For airline and charter aircraft operations, certain minimum visibility conditions must be met before the aircraft can take off. No minimums are set for operations by private aircraft operating under Federal Aviation Regulations Part 91. Also, instrument departures are permitted from any airport, even those without an instrument approach procedure.

Helicopter Flight Patterns

Normal flight patterns for helicopters are the same as those for airplanes in certain ways and are different in others. Most of the differences result from the distinct operating characteristics of helicopters.

- **Visual Flight Rules** — Helicopter flight under VFR conditions involves significant differences from airplane flight. For example, en route altitude is generally lower for helicopter flights than it is for airplanes. Federal Aviation Regulations Part 91 establishes the minimum en route altitude for all aircraft at 1,000 feet over urban areas and 500 feet over less populated locations. Helicopters, however, may be operated at less than these minimums if "the operation is conducted without hazard to persons or property on the surface."

The FAA has not established a standard airport traffic pattern for helicopters comparable to that for airplanes. FAR Part 91 dictates only that helicopters should "avoid the flow of fixed-wing traffic." This is often accomplished by flying both at a lower altitude than the airplane traffic pattern and along different routes. Also, many airports and heliports have adopted official or unofficial helicopter approach and departure routes.

Because helicopters require little or no landing or takeoff roll along the ground the way airplanes do, they can approach or depart a takeoff/landing site from virtually any direction when not limited by obstacles, established procedures, or other factors. Given the choice, helicopters, like airplanes, will land and takeoff as closely into the direction of the wind as possible. Helicopter landing approach and takeoff climb angles are comparatively steeper, however. Also, the length of these segments can be much shorter than needed for airplanes.

- **Instrument Flight Rules** – Under instrument weather conditions, helicopters mostly follow the same flight rules as airplanes. At airports, for example, helicopters use the same instrument approach and departure procedures as those flown by airplanes. Some helicopter facilities, however, may have instrument procedures exclusively for helicopter use.

Airport-Related Factors

Adjustments to standard traffic patterns frequently are made to reflect specific conditions at individual airports. Airports where multiple runways are simultaneously used may limit the pattern locations of individual runways in order to avoid air traffic conflicts. Similarly, when two or more airports are situated close together, limitations on their traffic pattern locations may be necessary.

High terrain on one side of an airport is another local condition which may dictate establishment of a right-hand pattern to a runway. Finally, the locations of traffic patterns and flight routes to and from an airport are sometimes defined so as to minimize aircraft overflight of residential or other noise-sensitive land uses.

Ground Operations

Although airborne aircraft operations are the primary source of aircraft noise in the vicinity of an airport, ground operations can also produce significant impacts under certain circumstances. Particular locations of ground operation noise include:

- **On the Runway** — Significant noise levels are generated behind an aircraft, especially a jet aircraft, as full engine thrust is produced during acceleration to takeoff. On landing, power settings on most aircraft are low and the noise is comparatively minimal. The one significant exception is when jet aircraft use reverse thrust to decelerate after landing. This action can produce high noise levels in front and to the sides of the aircraft. (Note: reverse thrust noise is included in standard INM computations.)

Airport land use commissions seldom adopt land use compatibility criteria which specifically consider noise from aircraft ground operations not on the runway. Nevertheless, these noise sources can be significant in locations immediately adjacent to an airport. The latest version of INM (4.11) allows some analysis of aircraft run-up noise.

- **At Runway Holding Bays** — Pre-flight engine run-ups by piston aircraft are usually conducted at holding bays or other locations near the ends of runways. In nearby areas, the resulting noise levels frequently are greater than for takeoffs and landings.

- **Fixed Base Operations Areas** — Maintenance testing of aircraft engines requires the use of high power settings and resulting noise levels. This activity may occur in or near fixed base operations maintenance hangars or sometimes at other locations on an airport.

- **Other Operations Areas** — Aircraft use low power settings when taxiing between parking locations and a runway. For most aircraft, the resulting noise levels are minimal and not a factor off the airport property. One exception to this normally low noise production occurs when a propeller aircraft is initially started. Moderately high engine power is briefly necessary to start the engine and begin taxiing. Noise levels increase correspondingly for these few moments.

Other Variables

The noise levels experienced on the ground as an aircraft flies over are primarily dependent upon the inherent loudness of the aircraft, the aircraft's altitude, and the horizontal distance between the measuring site and the aircraft flight track. Other variables are also important, however.

It should be noted that the cumulative noise level contours which ALUCs use for land use compatibility planning purposes normally do not take into account variables such as these. Unless special steps are taken to calibrate the noise contours for a particular airport with actual noise measurements taken at that airport, the contours will reflect conditions considered average for all airports.

- **Pilot Technique** — An important variable in aircraft noise is the pilot. Depending upon the techniques that the pilot employs, the same aircraft can generate significantly different noise levels. Conditions which produce some of the greatest noise variations include:
  - The angle of climb while on takeoff (also affected by aircraft payload, air temperature, and wind);
  - The propeller pitch setting on airplanes with variable pitch propellers, especially at high takeoff power settings;
  - Power adjustments during takeoff;

- Flap settings during landings (especially for large aircraft); and
- The airspeed and descent rate relationships that determine the extent of helicopter blade slap during landing operations.

Pilot awareness of the aircraft configurations that create abnormally high noise levels can be a significant factor in helping to reduce actual airport noise impacts.

- **Air Temperature** – On hot days, aircraft cannot climb as rapidly as when temperatures are cooler. Takeoff noise impacts consequently are stretched out over a greater distance from the runway end.

- **Sound Wave Reflections** – The presence of nearby structures or steep terrain can cause sound wave reflections which may locally increase noise levels. Certain meteorological conditions, particularly a solid, low cloud cover, also can reflect sound back to the ground, resulting in higher noise levels.

INM version 4.11 now allows some assessment of the effects of elevation variations.

- **Height of Terrain** – Rising or falling terrain changes the distance between an aircraft and people on the ground relative to the flat ground assumed in standard INM calculations. These changes in turn increase or reduce the actual sound levels experienced on the ground compared to the levels calculated by the noise model.

EFFECTS OF NOISE ON PEOPLE

Types of Effects

Noise, especially aircraft noise, affects people and their activities in varied and complex ways. Three principal types of effects can be identified: *physiological*, *behavioral*, and *subjective*.

- **Physiological Effects** – Physiological effects can be either temporary or permanent. Among the temporary effects are startle reactions and the effects of sustained sleep interference. Hearing loss is the most obvious permanent effect of noise. Research indicates that off-airport aircraft noise, even from the loudest aircraft, is not severe enough to produce permanent or even sustained (after the noise ceases) effects on hearing. Less is known about the nonauditory health effects of aircraft noise. A U.S. Environmental Protection Agency conclusion in 1982 remains valid today:

It can even be argued that, for aircraft noise, a relationship to physiological effects has not been proven to exist.

"Research implicates noise as one of several factors producing stress-related health effects such as heart disease, high blood pressure and stroke, ulcers and other digestive disorders. The relationship between noise and these effects has not yet been quantified."

Specific parameters of the behavioral effects of noise are described in the following section.

- **Behavioral Effects** – Behavioral effects are usually measured in terms of interference with human activities. Speech interference and interference with the enjoyment of radio or television are the most often cited examples. Interference with concentration on mental activities and disruption of sleep are two others. Most of the readily identifiable aircraft noise effects fall into this category.

See the next section for discussion of the characteristics of annoyance effects.

- **Subjective Effects** – By their very nature, subjective effects are unique to each individual and, therefore, difficult to quantify. Subjective effects of noise are commonly described in terms of *annoyance* or other similar terms. Because of the great variability in the ways people perceive and react to the unpleasant aspects of noise, prediction of how any one individual will react is nearly impossible. Most research consequently focuses on whole communities in order to identify predictable trends.

Parameters of Human Reactions to Noise

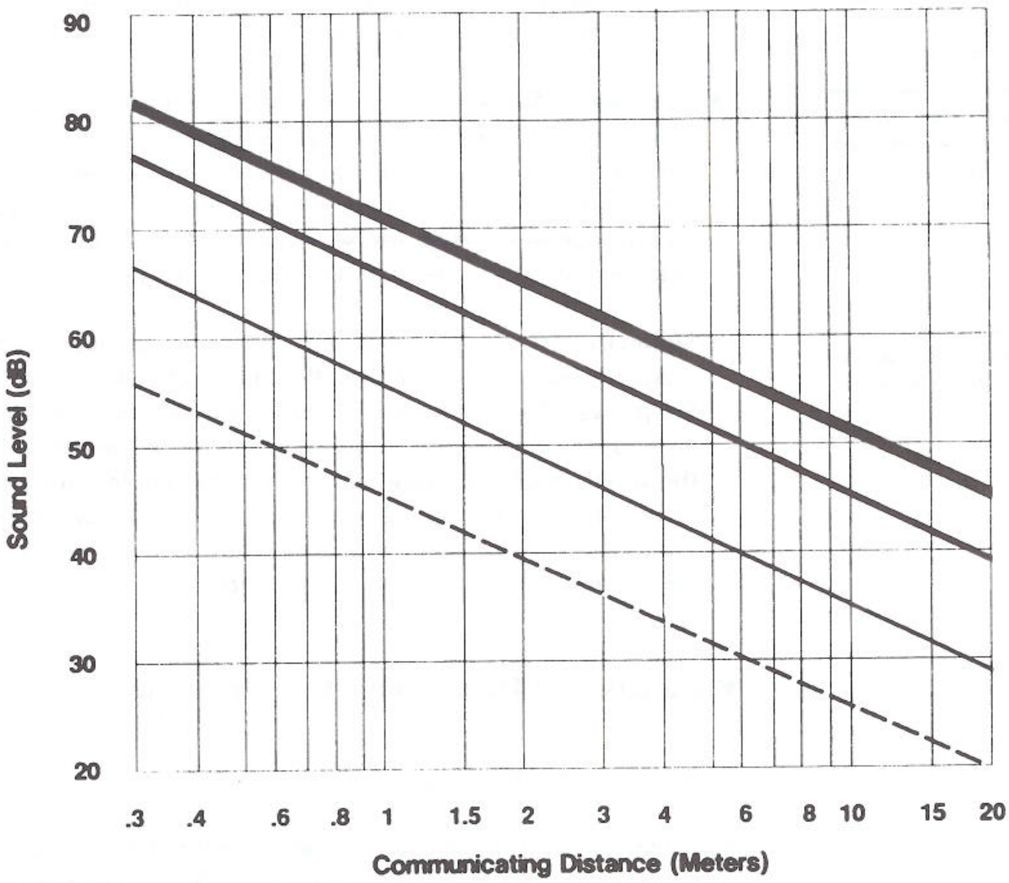
Speech Communication

Scientific research has found that the maximum continuous sound level that will permit relaxed conversation with 100% intelligibility throughout a typical residential living room (talker/listener separation greater than approximately 3.5 feet) is 45 dB (L_{eq} = 45 dB). A 95% intelligibility – considered to be "satisfactory conversation" – can be obtained with a steady sound level of up to 64 dB. When the noise level approaches 80 dB, intelligibility drops to near zero even when a loud voice is used (U.S. EPA – 1974). Interference to communication may result from masking of the speaker's words or by causing the speaker to pause.

Figure 6F illustrates the relationships between speech intelligibility, sound level, and distance.

Outdoors, because of the absence of reflecting walls to provide the reverberation found indoors, the sound level of speech as it reaches the ear decreases comparatively more rapidly with increasing distance between the talker and listener. In a steady background noise there comes a point, as the talker and listener increase their separation, where the decreasing speech signal is masked by the noise.

Almost all fluctuating sound levels found in the everyday environment will, if averaged over a long time period, have less impact on speech intelligibility than a steady sound which has the same Equivalent Sound Level (L_{eq}). This occurs because most of the time the background noise level is less than the Equivalent Sound Level (because of the logarithmic



Maximum distances outdoors over which conversation is considered to be satisfactorily intelligible in steady noise.

Raised voice satisfactory conversation (sentence intelligibility 95%)

Normal voice satisfactory conversation (sentence intelligibility 95%)

Relaxed conversation (sentence intelligibility 99%)

Relaxed conversation (sentence intelligibility 100%)

Source: U.S. Environmental Protection Agency (1974)

Figure 6F

Relationship Between Noise Levels and Conversation

base of sound intensity measurement, a loud sound need have only a relatively short duration to raise the L_{eq} substantially). In circumstances where assessment of speech interference is particularly important, measurement of the amount of time during which noise levels exceed a level for acceptable communication can be informative.

Sleep Disturbance

The extent to which environmental noise affects human sleep patterns varies greatly from individual to individual as well as from one time to another for any particular individual. Whether an individual is aroused by a noise depends upon the individual's sleep state and sleep habits, the loudness or suddenness of the noise, the information value of the noise, and other factors. Also, most people adapt over time to increased levels of noise during sleep.

When the noise source emanates from outdoors — as is the case with aircraft noise — additional factors affect the loudness of the noise as heard indoors. The noise level reduction provided by the type of structure is one of these determinants. A greater variable, though, is whether windows are open or closed.

Recent studies of people living near airports have produced inconsistent results as to the affect of aircraft-related noise on sleep disturbance. A British study (U.K. Department of Transport – 1992) found that an average person has only a 1 in 75 chance of being awakened by an aircraft noise in the *outdoor* range of 90 to 100 dB SEL. Allowing for the noise level reduction of the structure, this data indicates that *indoor* single-event sound levels of 70 to 80 dB will cause less than a 2% chance of sleep disturbance.

A direct comparison between the various studies is made more difficult by the fact that some are based on *indoor* noise levels, while others measured *outdoor* noise exposure.

In contrast, a U.S. Air Force study (Finegold – 1992; referenced in FICON) concluded that approximately 20% of the population can be expected to be awakened by *indoor* single-event sound levels (SEL) of 70 dB (Figure 6G). This percentage rises to nearly 50% at an SEL of 90 dB. Earlier studies documented by the U.S. Environmental Protection Agency (U.S. EPA – 1974) indicate even higher percentages of people likely to be awakened by noise levels in this range. The EPA report found that 60% of people are awakened by *outdoor* cumulative noise levels (DNL) of 65 dB (although there is no constant correlation, an airport-related DNL of 65 dB typically would mean that SELs are around 90 to 100 dB).Some of the discrepancies among these studies can probably be accounted for by the differences in the way people sleep in their own homes versus in a laboratory setting (people are more likely to be awakened by noise in a laboratory setting than in a familiar, home environment). Also, an important point to recognize here is the distinction between individual noise events and ambient noise levels. When background noise levels are low, a single noise having a maximum level of as little as 45 dB may cause some people to awaken, particularly if they have not become accustomed to such noises. On the other hand, a relatively constant noise of about the same level, may well cause less of a sleep disturbance in the majority of people.

Additional research clearly is needed to sort out the relationships between aircraft-related noise – as measured on a single-event versus cumulative noise exposure basis and indoors versus outdoors – and sleep disturbance.

Annoyance Factors

Numerous studies have been conducted which attempt to identify the types of factors that affect an individual's reaction to noise. Annoyance as assessed in most of these studies is not limited to reactions apart from interference with speech communication, disturbance to sleep, and other such behavioral effects. Rather, annoyance is a complex reaction to many physical and emotional factors, including adverse effects on behavior. The significance of these factors vary widely from individual to individual and, even for a given individual, from one set of circumstances to another.

Listed to the left, in no particular order, are many of the factors which have been demonstrated to influence the extent of an individual's annoyance at noise.

Factors Influencing Annoyance at Noise

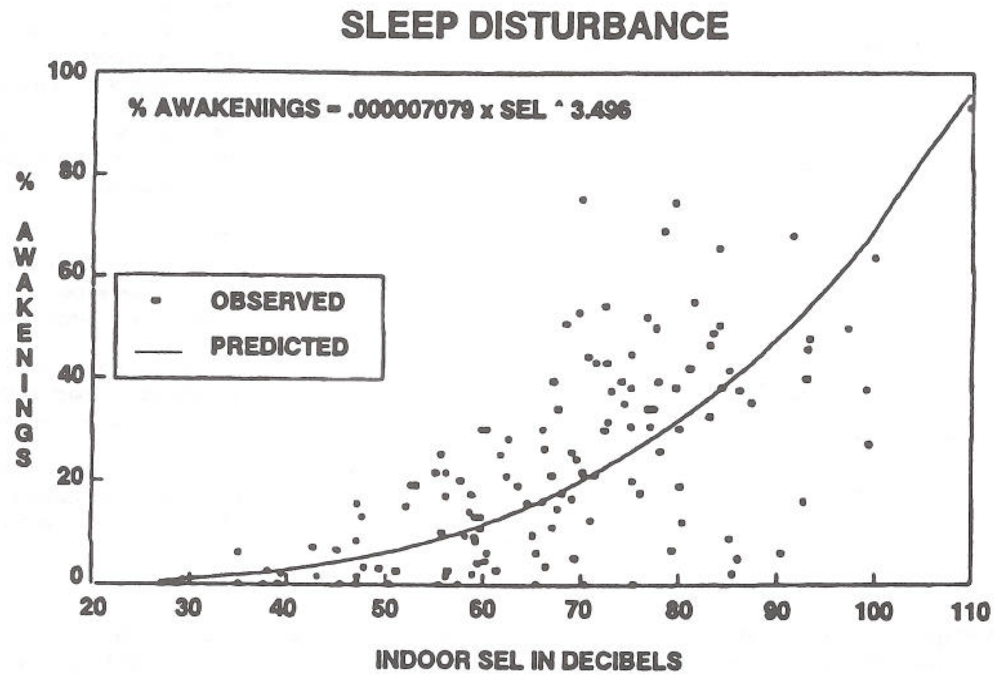
- Demographic characteristics of the individual (age, sex, economic status, etc.).
- Residential dwelling characteristics (single versus multi-family; owner-occupied versus rental).
- The loudness, tonal qualities, and other inherent unpleasant characteristics of the noise itself.
- How often the noise occurs.
- The predictability of the noise.
- Experience and expectations regarding noise levels in the community.
- Personal sensitivity to noise.
- Beliefs regarding the preventability of the noise.
- Attitudes regarding the importance of the activity associated with the noise.
- Perceptions concerning the extent to which efforts have been made to minimize the noise levels.
- The activity in which the individual is engaged at the time of the noise.
- Beliefs regarding the health effects of noise.
- Feelings of fear or anxiety associated with the noise.

The last factor in the adjacent list suggests that annoyance is not strictly a noise-derived phenomenon, but one which also involves a safety component. This factor is particularly important with respect to annoyance at aircraft overflights. Although people may not fear the aircraft noise itself, they may be apprehensive of the prospect that an aircraft could crash onto their property, and it is the noise that mostly creates their awareness of the aircraft's presence. The altitude of the aircraft and individuals' understanding of how aircraft fly thus are additional factors in the airport-related annoyance equation.

Community Reactions to Noise

Even though studies have been able to identify most of the factors affecting an individual's annoyance at noise, predicting how any one individual will react to typical environmental noises has proved virtually impossible. Consequently, most studies which seek to predict noise-based annoyance focus on the reactions of communities as a whole rather than on those of individuals. This approach also reflects the fact that, for the purpose of developing noise policies, community reactions are more significant than individual reactions.

A summary of the effects of noise on people, including the reactions of average communities is presented in the FICON report. This summary is reproduced here as Table 6C.



Source: *Finegold et al. (1992)*

Figure 6G

Relationship Between Noise Levels and Sleep Disturbance

Day-Night Average Sound Level *(Decibels)*	**Effects**[1]			
	Hearing Loss *(Qualitive Description)*	**Annoyance**[2] *(Percentage of Population Highly Annoyed)*[3]	**Average Community Reaction**[4]	**General Community Attitude Toward Area**
≥75	May begin to occur	37%	Very severe	Noise is likely to be the most important of all adverse aspects of the community environment.
70	Will not likely occur	22%	Severe	Noise is one of the most important adverse aspects of the community environment.
65	Will not occur	12%	Significant	Noise is one of the important adverse aspects of the community environment.
60	Will not occur	7%	Moderate to Slight	Noise may be considered an adverse aspect of the community environment.
≥55	Will not occur	3%		Noise considered no more important than various other environmental factors.

1. All data is drawn from National Academy of Science 1977 report *Guidelines for Preparing Environmental Impact Statements on Noise*, Report of Working Group 69 on Evaluation of Environmental Impact of Noise.

2. A summary measure of the general adverse reaction of people to living in noisy environments that cause speech interference; sleep disturbance; desire for tranquil environment; and the inability to use the telephone, radio or television satisfactorily.

3. The percentage of people reporting annoyance to lesser extents are higher in each case. An unknown small percentage of people will report being "highly annoyed" even in the quietest surroundings. One reason is the difficulty all people have in integrating annoyance over a very long time. USAF Update with 400 points (Finegold et al. 1992)

4. Attitudes or other non-acoustic factors can modify this. Noise at low levels can still be an important problem, particularly when it intrudes into a quiet environment.

NOTE: Research implicates noise as a factor producing stress-related health effects such as heart disease, high blood pressure and stroke, ulcers and other digestive disorders. The relationships between noise and these effects, however, have not as yet been conclusively demonstrated. (Thompson 1981; Thompson et al. 1989; CHABA 1981; CHABA 1982; Hattis et al. 1980; and U.S. EPA 1981)

Source: Federal Interagency Committee on Noise (1992)

Table 6C

Summary of Effects of Noise on People

Residential Land Uses

Percentage of People Highly Annoyed

Perhaps the most comprehensive and widely accepted evaluation of the relationship between transportation noise exposure (not exclusively aviation noise) and community annoyance was one originally developed by Schultz (1978) and more recently updated by the U.S. Air Force (Finegold – 1992). This relationship — known as the Schultz curve (Figure 6H) — indicates the percent of people predicted to be *highly annoyed* (%HA) at various levels of noise exposure measured in terms of the DNL metric. Both of these studies represent compilations of findings from a number of social surveys conducted by other researchers.

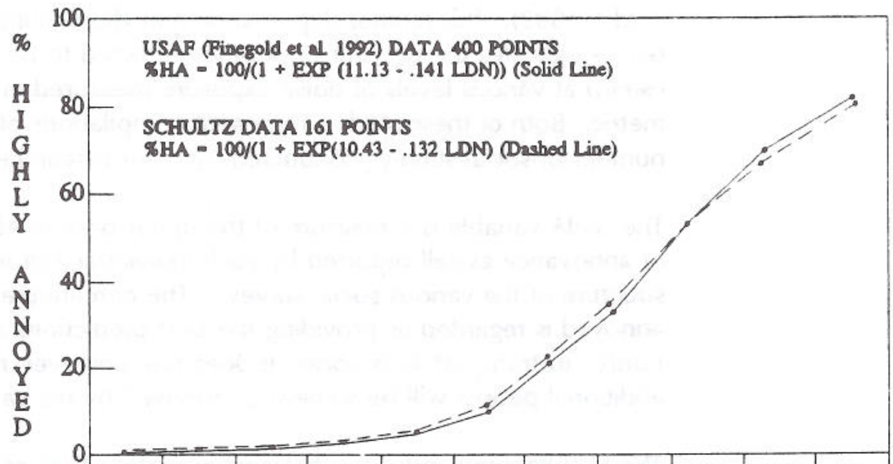
The %HA variable is a measure of the upper portion of the distribution of annoyance as self-reported by each individual, but within the precise structure of the various social surveys. The percentage of people highly annoyed is regarded as providing the best predictions of community responses to transportation noise. It does not, however, reflect the fact that additional people will be *somewhat* annoyed by the same noise levels.

The Schultz curve indicates that approximately 13% of the population is highly annoyed at noise levels below a DNL of 65 dB. Beyond that noise level, the %HA increases rapidly. This sharp increase of %HA beginning at DNL 65 dB supports the selection of that noise level as the dividing point between normally compatible and normally incompatible residential land use (see next chapter). The extremes of the curve are also worth noting. At the low end, the data reflects the findings of social surveys that a few people will be highly annoyed regardless of how minimal the noise level is (about 0.5% at a DNL of 40 dB). Oppositely, nearly 20% of the population is apparently not highly annoyed even at a DNL of 90 dB.

Significance of Background Noise Levels

A variable not specifically accounted for in the Schultz curve is the level of background or ambient noise in a community. Although generally recognizing that this variable is a factor in annoyance, researchers have not yet developed a consensus as to the extent of its significance.

In the early use of the Day-Night Average Sound Level as a tool for land use planning, the EPA suggested that corrections be applied to the measured or calculated noise levels in order to *normalize* the exposure relative to the indicated land use compatibility guidelines (U.S. EPA – 1974). These corrections (see Table 6D) primarily reflect existing noise exposure conditions of the community, both ambient and from specific noise sources such as airport activity. Moreover, the difference between the normalized DNL of identifiable intruding noise and the DNL of background noise was stated as being a strong indicator of whether noise complaints can be anticipated.



Day - Night Average Sound Level in dB		40	45	50	55	60	65	70	75	80	85	90
Calculated %HA Points	USAF	0.41	0.831	1.66	3.31	6.48	12.29	22.1	36.47	53.74	70.16	82.64
	SCHULTZ	0.576	1.11	2.12	4.03	7.52	13.59	23.32	37.05	53.25	68.78	81

Comparison of logistic fits to original 161 data points of Schultz (1978) and USAF analysis with 400 points (data provided by USAF Armstrong Laboratory)

Source: Federal Interagency Committee on Noise (1992)

Figure 6H

Relationship Between Noise Levels and Annoyance

Type of Correction	Description	Amount of Correction to be Added to Measured DNL in dB
Seasonal Correction	Summer (or year-round operation).	0
	Winter only (or windows always closed).	− 5
Correction for Outdoor Noise Level Measured in Absence of Intruding Noise	Quiet suburban or rural community (remote from large cities and from industrial activity and trucking).	+10
	Normal suburban community (not located near industrial activity).	+5
	Urban residential community (not immediately adjacent to heavily-traveled roads and industrial areas).	0
	Noisy urban residential community (near relatively busy roads or industrial areas).	− 5
	Very noisy urban residential community.	− 10
Correction for Previous Exposure & Community Attitudes	No prior experience with the intruding noise.	+5
	Community has had some previous exposure to intruding noise but little effort is being made to control the noise. This correction may also be applied in a situation where the community has not been exposed to the noise previously, but the people are aware that bona fide efforts are being made to control the noise.	0
	Community has had considerable previous exposure to the intruding noise and the noise maker's relations with the community are good.	− 5
	Community aware that operation causing noise is very necessary and it will not continue indefinitely. This correction can be applied for an operation of limited duration and under emergency circumstances.	− 10
Pure Tone or Impulse	No pure tone or impulsive character.	0
	Pure tone or impulsive character present.	+5

Source: U.S. Environmental Protection Agency (1974)

Table 6D

Corrections Factors for Obtaining Normalized DNL

However, the FICON technical report concludes that, "although background noise effects probably do modify community responses to aircraft noise exposure," "in the present state of the art, there is not sufficient data to establish a quantitative adjustment for background noise in analyzing aircraft noise impact" (pages 2–10 and 2–11). "All that can be recommended at present is that background noise should be addressed in those cases where there is reason to believe that it will have an effect on community annoyance" (page 2–11).

Currently on-going studies by the U.S. Forest Service and the National Parks Service are aimed at determining whether any *detectable* level of intruding noise adversely affects the enjoyment of wilderness and other natural settings. New insights into the relationship between ambient and intruding noise may emerge from those studies.

Complaints

Social survey data, such as represented by the Schultz curve, help in determining a *typical* community's reaction to noise. An approach to evaluating a *specific* community's reaction to noise is to examine the noise complaint history. Many airports maintain logs of noise complaints received.

There are limitations to this approach, however. Most significantly, complaints are not necessarily representative of community annoyance. As noted in the FICON technical report (page 3–6), annoyance can exist without resulting in complaints and complaints may occur even without a high degree of community annoyance. Most complaints tend to be associated with either:

- Specific events – such as exceptionally loud, large, or low-flying aircraft or changes in flight patterns – which are not normal for the airport; or
- A small number of people who frequently complain about airport activities.

Other Variables in Airport-Related Noise Annoyance

Several other inter-related variables appear to influence the extent of community annoyance at airport noise. For some of these, relatively little research has been conducted. The apparent significance is thus more anecdotal than quantified.

- **Differences between Airport and Highway Noise** – The Schultz curve is based upon the findings of research on all types of transportation noise. However, some studies have suggested that aircraft noise is considerably more annoying than highway noise at the same DNL exposure (Ward – 1989). An explanation for this difference is that the greater variability of aircraft noise and the associated higher maximum noise levels produce greater interference with people's activities. An additional explanation may be that aircraft overflights create more apprehension than that resulting from highway traffic.

- **Differences among Airport Types** — Virtually all research on airport noise has been conducted at major airline airports, most of which are located in urban areas. The aircraft activity at these airports generates relatively predictable, frequent, loud noise events. In contrast, most general aviation airports have relatively few loud noise events and the total number of aircraft operations may vary substantially from day to day. Also, many general aviation airports are located in quiet, rural settings. Unclear from the literature is how the resulting community annoyance differs from that in the vicinity of airline airports. However, the experience of many general aviation airports suggests that, for locations with comparable noise exposure (measured in terms of DNL or CNEL), the degree of annoyance — or at least the number of complaints — is greater than at airline airports.

- **Significance of Flight Frequency versus Noise Event Loudness** — A common element in the preceding two factors is the relationship between the sound level of individual noise events, the number of events, and the degree of community annoyance. Because of the way in which time-weighted cumulative noise metrics are calculated, a 3 dB increase in the average sound level of individual aircraft noise events has the same effect on cumulative measure as does a doubling of the number of events.

  The question this poses for airline airports is whether future reductions in the noise levels of aircraft operations, coupled with growth in the number of operations, will result in increased community annoyance even if the cumulative noise level remains constant. Some researchers conclude that annoyance will increase under such circumstances; yet other studies have found to the contrary that, beyond a certain frequency, additional aircraft operations add little to community annoyance. More field studies will need to be conducted to provide a better understanding of how the extent of annoyance resulting from a specific level of cumulative noise exposure is affected by variations in flight frequency and the sound level of individual events. Such studies would also be of value to busy general aviation airports.

- **Time of Day Weighting** — Some evidence suggests that, because people are more likely to be home during the evening than in the day, the inclusion of a penalty factor on evening aircraft operations is appropriate. This consideration is reflected in the CNEL metric. Other researchers, supported by the British sleep disturbance study, believe that the nighttime weighting should be reduced or eliminated. At the present time, no consensus has been reached on this issue.

Chapter 7

Noise Compatibility Policy Issues

7

Noise Compatibility Policy Issues

ESTABLISHED REGULATIONS AND POLICIES

The discussion in the preceding chapter provides a theoretical foundation upon which airport land use commissions can establish noise compatibility policies for airport environs. Additional factors to consider are the various noise-related laws, regulations, and policies adopted by federal and state governments.

Other issues associated with development of noise compatibility policies and criteria are examined in the remainder of this chapter.

Laws and statutes enacted by the U.S. Congress and the California State Legislature typically set general requirements and the authority for administrative adoption of more detailed regulations and policies. With respect to airports, most of the administrative actions are taken by the Federal Aviation Administration and the California Department of Transportation (Caltrans) Division of Aeronautics. These laws and regulations establish the basis for local development of airport plans, analyses of airport impacts, and enactment of compatibility policies. Brief descriptions of selected laws, regulations, and policies having particular significance to noise issues are provided in the paragraphs which follow.

Federal

Laws

- **U.S. Department of Transportation Noise Abatement Policy** — This policy, adopted in 1976, sets forth the noise abatement authority and responsibilities of the federal government, airport proprietors, state and local governments, the air carriers, air travelers and shippers, and airport area residents and prospective residents. The basic thrust of the policy is that the FAA's role is primarily one of regulating noise at its source (the aircraft) plus supporting local efforts to develop airport noise abatement plans. The FAA will give high priority in the allocation of Airport Improvement Program funds to projects designed to ensure compatible use of land near airports. However, it is the role of state and local governments and airport proprietors to undertake the land use and operational actions necessary to promote compatibility.

- **Aviation Safety and Noise Abatement Act of 1979** — Further weight was given to the FAA's supporting role in noise compatibility planning by congressional enactment of this legislation. Among the stated purposes of this act is "to provide assistance to airport operators to prepare and carry out noise compatibility programs." The law establishes funding for noise compatibility planning and sets the requirements by which airport operators can apply for funding. The law does not require any airport to develop a noise compatibility program.

- **Airport Noise and Capacity Act of 1990** — In adopting this legislation, Congress' stated intention was to try to balance local needs for airport noise abatement with national needs for an effective air transportation system. To accomplish this objective, the act did two things:
  - It directed the FAA to establish a national program to review noise and access restrictions on aircraft operations imposed by airport proprietors; and
  - It established requirements for the phase-out of older model, comparatively louder, *Stage 2* aircraft from the nation's airline fleet.

Federal Aviation Regulations (FAR)

- **Part 36 (Noise Standards: Aircraft Type and Airworthiness Certification)** — This part of the Federal Aviation Regulations specifies the noise standards that individual types of aircraft are required to meet as part of their airworthiness certification. It includes noise level standards for certification of new types of propeller-driven, small airplanes, as well as for transport category, large airplanes. As originally adopted in 1960, FAR Part 36 only prescribed noise standards for issuance of new aircraft type certificates. Subsequent amendments extended the standards to certain newly produced aircraft of older type designs. Other amendments have at various times extended the required compliance dates.

  These regulations establish maximum noise levels for aircraft based upon aircraft weight and the number of engines. All airline aircraft currently being operated in the United States meet either the *Stage 2* or more stringent *Stage 3* standards. Airlines are required by the Airport Noise and Capacity Act of 1990 to phase out the use of Stage 2 aircraft by the year 2000. Comparable aircraft (those having similar gross weights and numbers of engines) meeting the Stage 3 standards are quieter than comparable Stage 2 aircraft. However, light Stage 2 aircraft may be quieter than heavy Stage 3 aircraft. The regulations make no determination that the new aircraft are acceptably quiet for operation at any given airport. Rather, the regulations are intended to establish national maximum aircraft noise-emission levels.

- **Part 150 (Airport Noise Compatibility Planning)** — As a means of implementing the Aviation Safety and Noise Abatement Act of 1979, the Federal Aviation Administration adopted these regulations establishing a voluntary program which airports can utilize to conduct airport noise compatibility planning. "This part prescribes the procedures, standards, and methodology governing the development, submission, and review of airport noise exposure maps and airport noise compatibility programs, including the process for evaluating and approving or disapproving these programs." Part 150 also prescribes a system for measuring airport noise impacts and presents guidelines for identifying incompatible land uses. Airports which choose to undertake a Part 150 study are eligible for federal funding both for the study itself and for implementation of approved components of the local program.

  The noise exposure maps are to be depicted in terms of Yearly Day-Night Average Sound Level (L_{dn}) contours around the airport. All land uses are considered compatible with noise levels of less than L_{dn} 65 unless the local jurisdictions can document the appropriateness of a lower standard. At higher noise exposures, selected land uses are also deemed acceptable, depending upon the nature of the use and the degree of structural noise attenuation provided.

  In setting the various compatibility guidelines, however, the regulations state that the designations:

  > "...do not constitute a federal determination that any use of land covered by the [noise compatibility] program is acceptable or unacceptable under federal, state, or local law. The responsibility for determining the acceptable and permissible land uses remains with the local authorities. FAA determinations under Part 150 are not intended to substitute federally determined land uses for those determined to be appropriate by local authorities in response to locally determined needs and values in achieving compatible land uses."

- **Part 161 (Notice and Approval of Airport Noise and Access Restrictions)** — This part of the federal regulations implements the Airport Noise and Capacity Act of 1990. It codifies the analysis and notification requirements for airport proprietors proposing aircraft noise and access restrictions on Stage 2 or Stage 3 aircraft. The requirements are more stringent with respect to the quieter, Stage 3, aircraft. The analysis requirements are closely tied to the process set forth by FAR Part 150.

Other Federal Regulations and Guidelines

- **Environmental Protection Agency "Levels Document"** — One of the more fundamental set of guidelines on noise impacts was published by the EPA in 1974. Entitled *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*, it is better known as the "Levels Document." The document does not constitute EPA regulations or standards. Rather, it is intended to "provide state and local governments as well as the federal government and the private sector with an informational point of departure for the purposes of decision-making." Using the Yearly Day-Night Average Sound Level (L_{dn}) as a measure of noise acceptability, the document states that "undue interference with activity and annoyance" will not occur if *outdoor* noise levels in residential areas are below L_{dn} 55 and *indoor* levels are below L_{dn} 45.

- **Federal Interagency Committee on Urban Noise (FICUN)** — The product of this committee was a 1980 report entitled *Guidelines for Considering Noise in Land Use Planning and Control*. These guidelines do not replace those of individual federal agencies, but rather serve to establish a common basis upon which agency standards can be developed. The report features a table indicating the compatibility or incompatibility of various land uses listed according to their standard land use code (SLUC). All land uses are considered compatible with noise levels less than L_{dn} 65. Beginning at that level, residential and certain other land uses are judged compatible only if adequate noise level reduction is provided by the structure.

- **Department of Housing and Urban Development (HUD) Regulations** — HUD guidelines for the acceptability of residential land use parallel those suggested in the FICUN report: noise exposure of DNL 65 dB or less is acceptable; between 65 and 75 dB is normally acceptable if appropriate sound attenuation is provided; and above DNL 75 dB is unacceptable (U.S. HUD – 1985). The goal for interior noise levels is DNL 45 dB. These guidelines apply only to new construction supported by HUD grants and are not binding upon local communities.

- **Department of Defense Air Installation Compatible Use Zone (AICUZ) Program** — The AICUZ program was established by the Department of Defense in 1973 as an effort to protect the federal government's investment in military airfields. The current noise compatibility criteria are basically the same as those indicated in the FICUN report and the FAA's Part 150 program. AICUZ plans prepared for individual airfields are primarily intended as recommendations to local communities regarding the importance of maintaining land uses which are compatible with the noise and safety impacts of military aircraft operations.

Also contained in the FICON report is a summary of the noise policies and programs of federal agencies. This summary is shown here as Table 7A.

- **Federal Interagency Committee on Noise (FICON)** – This committee's 1992 report, discussed in Chapter 6 and later in this chapter, constitutes the federal government's most recent review of noise policies that govern the assessment of airport noise impacts. The FICON review primarily focused on:
  - "The manner in which noise impacts are determined, including whether aircraft noise impacts are fundamentally different from other transportation noise impacts;
  - "The manner in which noise impacts are described;
  - "The extent of impacts outside of Day-Night Average A-Weighted Sound Level (DNL) 65 decibels (dB) that should be reviewed in a National Environmental Policy Act (NEPA) document;
  - "The range of Federal Aviation Administration (FAA)-controlled mitigation options (noise abatement and flight track procedures) analyzed; and
  - "The relationship of the FAA Federal Aviation Regulations (FAR) Part 150 process to the NEPA process; including ramifications of the NEPA process if they are separate, and exploration of the means by which the two processes can be handled to maximize benefits."

State of California

- **State Aeronautics Act** – Chapter 4, Article 3, Section 21669 of the State Aeronautics Act (Division 9, Part 1 of the California Public Utilities Code) requires the State Division of Aeronautics to adopt noise standards applicable to all airports operating under a state permit.

- **California Airport Noise Standards** – The standards promulgated in accordance with the State Aeronautics Act are set forth in the California Code of Regulations, Title 21, Chapter 2.5, Subchapter 6, Sections 5000 et seq. The most recent revisions to the regulations became effective in March 1990.

  > "The regulations are designed to cause the airport proprietor, aircraft operator, local governments, pilots, and the [Division of Aeronautics] to work cooperatively to diminish noise problems. The regulations accomplish these ends by controlling and reducing the noise impact area in communities in the vicinity of airports."

  The regulations state that:

  > "The standard for the acceptable level of aircraft noise for persons living in the vicinity of airports is hereby established to be a community noise equivalent level of 65 decibels. This standard forms

CNEL shall be determined from the airport land use plan prepared by the county wherein the airport is located. For military bases, the L_{dn} shall be determined from the facility Air Installation Compatible Use Zone (AICUZ) plan. For all other airports or heliports, or public use airports or heliports for which a land use plan has not been developed, the L_{dn} or CNEL shall be determined from the noise element of the general plan of the local jurisdiction.

"When aircraft noise is not the only significant source, noise levels from all sources shall be added to determine the composite site noise level."

- **California Noise Planning in Land Use Act** – California Government Code, Division 1, Section 65302(f), requires that a noise element be included as part of local general plans. Airports are among the noise sources specifically to be analyzed. Noise contours, expressed in terms of either CNEL or L_{dn}, are to be shown down to 60 dB.

NOISE EXPOSURE MEASUREMENT ISSUES

The development of noise compatibility policies and associated criteria can be considered in terms of several individual issues. Some of these issues involve choices which each airport land use commission must make while also taking into account the needs of the county's communities. The discussion in the remainder of this chapter expands upon these noise and overflight compatibility topics, most of which are also noted in the beginning of Chapter 3.

Airport Activity Level Assumptions

One of the choices to be made in development of noise contours for an airport is what aircraft activity level to use as the basis for the computations.

State statutes regarding compatibility plans for airports specify that the plans must have at least a 20-year outlook. A 20-year activity forecast is usually included in airport master plans; also, individual airport forecasts with a similar time frame are available from the California Division of Aeronautics. A 20-year forecast is thus the most commonly used basis for noise contour calculations.

Forecasting is far from an exact science, however. Aviation forecasts prepared during the robust growth of the 1970s anticipated tremendous growth in all activity categories over the subsequent 20-year period. The reality, especially for general aviation, has been different, however. More recent forecasts anticipate much more modest growth rates.

Airline Airports

Major airline airports continued to experience substantial annual increases in aircraft operations through the 1980s, but this rate declined in the early 1990s along with the nationwide economic slump. The FAA's forecast of airline aircraft operations nationwide projects an average annual increase of 2.2% over the 12-year forecast period from 1993 through 2004 (FAA – 1993a). Long-range activity forecasts for major airline airports are available from various sources, including the FAA, the California Division of Aeronautics, and the individual airport master plans. The state law gives preference to airport master plans for the purposes of compatibility planning done by airport land use commissions. However, these forecasts are usually sufficiently consistent that any could serve as the basis for noise exposure modelling.

Airline aircraft operations at most airports in smaller communities have historically fluctuated from year to year and, at some airports, have disappeared altogether. No discernable change in this irregular trend is expected in the foreseeable future. The approaches discussed below with respect to general aviation airport activity projections should be considered.

General Aviation Airports

General aviation activity nationwide decreased sharply during the early 1980s and has remained relatively steady since then. The FAA currently forecasts limited growth in general aviation hours flown — 1.4% per year — through 2004. Turboprop and turbojet airplanes, along with turbine-powered helicopters, are expected to have the strongest growth rates — 2.8% and 7.6%, respectively (FAA – 1993a).

Although forecasts developed as part of master plans for individual general aviation airports tend to be more optimistic than national forecasts, most nevertheless anticipate only modest growth over their typical 20-year forecast period. Airports, though, presumably have a life span of more than 20 years and it is impossible to anticipate what activity levels might ultimately occur. The danger in using recent 20-year forecasts to determine airport land use noise compatibility, therefore, is that the forecasts might underestimate the eventual airport activity and noise impacts.

Two alternatives to the 20-year forecast period should be considered as the basis for noise compatibility planning:

- **Airport Capacity** — One alternative is to base an airport's noise impact contours on the operational capacity of the airport runway system. This approach may be reasonable at very busy airports, but at many others it would result in exaggerated noise contours that, in all likelihood, will never be achieved.

- **Forecast Extension** — Another option is to utilize available forecasts for an airport and extend them farther into the future. This can be done by taking existing forecasts (from master plans or the state airport system plan) and adding a fixed percentage to the total operations (say 50%, for example). The resulting activity level is for an indefinite point in time that probably will be well beyond 20 years unless a prolonged up-turn in general aviation activity occurs.

Other Noise Contour Input Data

Aircraft Types and Noise Generation

An important choice to be made in the preparation of projected future noise contours for an airport is selection of the aircraft fleet mix. As described earlier in this chapter and in Chapter 6, newer, quieter types of jet aircraft are scheduled to replace older, noisier models by the year 2000. Beyond that time frame, it is uncertain how much quieter jet aircraft can and will become. Since the built-in database of the FAA's Integrated Noise Model includes only aircraft which are already in existence, most noise contour calculations select from among these aircraft rather than attempting to define a hypothetical future aircraft. For projections 20+years into the future, the quietest types of existing jet aircraft are usually selected as representative of unknown future aircraft models.

With respect to propeller aircraft, any reduction in noise generation of average aircraft in the fleet is likely to be minimal. Current model aircraft thus can quite realistically be chosen for the purposes of calculating future noise impacts.

Distribution of Operations

Another set of assumptions which must be entered into the calculation of future noise contours concerns the distribution of operations by time of day, runway use pattern, and flight tracks. Adopted airport plans proposing modifications to the physical configuration of the runway system should be taken into account in this determination in that such changes usually will result in a different distribution of operations. Proposed establishment of new instrument approach or departure procedures or adoption of operational policies or restrictions can also affect airport use patterns. Lacking the existence of proposals such as these, the safest choice generally is to assume continuation of the present operations distributions.

Implications of Changing Contour Sizes

For most airports, particularly airline airports and busy general aviation facilities, noise contours projected for future years will differ in size from contours representing existing conditions. Depending upon the circumstances, the future contours may be either larger or smaller than the present ones. Each of these possibilities has implications for compatible land use planning.

Expanding Contours

At general aviation airport, especially ones with few jet aircraft operations, noise contours can be expected to expand along with future increases in activity, if any. Airline airports already having a high percentage of Stage 3 (comparatively quiet) aircraft operations also may experience future expansion of noise contours. To assure maximum long-term land use compatibility, the largest contours that can realistically be projected should be utilized.

Shrinking Contours

Over approximately the last decade and continuing into the 1990s, the replacement of relatively noisy jet aircraft with newer, quieter models has resulted in substantial reductions in the size of noise contours at most major airline airports. This shrinking of airport noise impact areas has often been accompanied by pressures to allow development of noise-sensitive land uses closer to airports. In some cases, such development might be reasonable. *In general, however, airport land use commissions and local planners should resist the temptation to permit these uses.*

The principal danger lies in the reasonably predictable prospect that airline airport noise contours may begin expanding again after the year 2000. As is the case with general aviation airports, providing maximum protection for airline airports requires looking at potential noise exposure levels well beyond the end of this decade and even beyond the 20-year time frame. Another factor lending credence to use of the largest contours is the increasing public awareness and reaction to noise. Compatibility criteria ten or twenty years from now may well set a DNL or CNEL (or the equivalent) of 60 dB as the upper limit of noise acceptable for residential land uses.

Other Sources of Aircraft Noise

Noise contours calculated with the FAA's Integrated Noise Model normally only take into account airplane takeoffs and landings. Other sources of aircraft noise are typically not included even though they may be significant in certain circumstances.

- **Engine Run-Up Noise** — Many people perceive the noise from preflight run-ups of propeller-aircraft engines to be more annoying than the noise from overflights, even if the sounds have equal loudness. Part of the reason for this greater annoyance is that run-up noise is

As noted in Chapter 6, the just-released version of INM (4.11) allows certain engine run-up noise events to be included in the calculations.

thought to be less necessary and more under the control of the aircraft operator. For land uses near the end of a runway, run-up noise can be louder and more prolonged than overflight noise. This is especially true when a runway is used predominantly in one direction. The runway end which is used for landings – when aircraft are typically the quietest – is also the end at which pre-flight engine run-ups are normally conducted.

In terms of potential airport land use commission policies, run-up noise has similarities to single-event noise. ALUC's do not have the authority to regulate the noise at its source, but can consider it in land use compatibility evaluation.

- **Helicopter Noise** – Because of their separate flight tracks, different operating characteristics, and typically low activity volumes, helicopter operations are usually not included in noise contour calculations. A simulation of helicopter noise can be included in Integrated Noise Model calculations. Also, the noise impacts of some types of helicopters can be modeled with the separate FAA Helicopter Noise Model (HNM) or the U.S. Air Force NOISEMAP model and the impacts then manually added to airplane impacts calculated with INM. Regardless of the modeling method used, inclusion of helicopter noise in computation of airport noise contours is encouraged, especially at airports having frequent helicopter activity.

- **Agricultural Aircraft Noise** – In agricultural locations, agricultural *crop duster* aircraft often are the principal contributors to an airport's overall noise impact. Agricultural aircraft noise differs from that of other aircraft and is difficult to accurately portray in airport noise contours.
  - For one, specialized agricultural aircraft are not included in the INM database. Agricultural aircraft thus must be represented by other aircraft or, preferably, the necessary data can be generated by field measurements.
  - More important distinctions are that these aircraft seldom climb to normal traffic pattern altitudes and they often make turns at low altitudes close to the runway. Unless numerous flight tracks are modelled, the calculated noise contours tend to maintain a constant width along the flight tracks and never reach a closure point.
  - Thirdly, because of the low flight altitudes and typically loud noise emissions of agricultural aircraft, noise impacts may be greater in the vicinity of agricultural fields that require frequent spraying than they are around low-activity airports. Although these impacts cannot be modelled – and are not ALUC concerns – they should be considered in local agencies' land use planning for agricultural areas.

DETERMINING ACCEPTABLE NOISE LEVELS

As suggested by the background discussion in the preceding chapter, there are no absolute scientific measures for establishing which land uses and noise exposures are or are not compatible with each other. The best that can be hoped for is that compatibility criteria will reflect what is *acceptable* to an *average* person in the communities involved. A basic purpose of the Schultz curve depiction of the percentages of people highly annoyed by various noise levels is to assist in determining acceptability. It is important to remember, however, that what may be considered an *acceptable* level of noise to a reasonable person will not satisfy 100% of the public.

Acceptable Cumulative Noise Levels

Cumulative noise exposure metrics remain the principal tool for assessment of the noise levels considered acceptable or compatible with various land uses.

Residential Areas

Noise compatibility standards, such as those summarized at the beginning of this chapter, typically place primary emphasis on residential areas. Residential development is not only one of the most noise-sensitive land uses, it usually covers the greatest proportion of urban land. Several factors contribute to this sensitivity:

- Normal residential construction usually provides less sound attenuation than typical commercial construction and windows are more likely to be open;
- Outdoor activity is a significant aspect of residential land use; and
- People are particularly sensitive to noise at night when they are trying to sleep.

There are three basic choices as to where to set the limit for acceptable residential noise exposure. The choices and the rationale for each are listed in Table 7B.

Other Land Uses

Chapter 3 discusses alternative methods of categorizing land uses.

Data on acceptable noise exposure for other noise-sensitive land uses is not as extensive as for residential uses. Some guidelines exist in the various documents cited earlier in this chapter. In general, once a criterion has been set for residential uses, the criteria for other land uses can be established by considering their degree of structural sound attenuation, outdoor activity, and so on relative to residential uses. The extent to which land uses types are grouped or separated into categories for the purpose of compatibility evaluation is a question of ease of use as discussed in Chapter 3.

Other Measures of Noise Compatibility

Although not always easy to specifically incorporate into noise compatibility policies, other factors can play important secondary roles in the determination of noise level acceptability.

Single-Event Noise Levels

As noted in the previous chapter, there is increasing interest at the national level regarding establishment of some form of single-event noise descriptor to supplement the cumulative measure provided by the DNL metric. In California, the removal of statewide single-event noise standards from the state regulations has not prevented many airport proprietors from successfully implementing single-event standards for aircraft operating at their airports. These single-event standards have been based upon either the noise levels published by the FAA in accordance with FAR Part 36 or actual measured noise levels recorded at the individual airport.

Airport land use commissions cannot set limits for the noise generated by individual aircraft overflights. So doing would be regarded as a direct regulation of airport operations. Nothing legally precludes airport land use commissions from considering single-event noise levels *as a factor in evaluating land use compatibility*, but the limitations of any such application should be recognized.

A basic difficulty in development of single-event noise level criteria applicable to land use compatibility assessment is the lack of useful aircraft noise data. Each of the available data sources has significant shortcomings.

- **FAR Part 36 Data** – The data resulting from FAR Part 36 is of value only in distinguishing the relative loudness of different types of aircraft. The actual points established by the regulations for measurement of noise levels are too far from the runway to be of much significance in land use planning, especially at general aviation airports.

- **Recorded Data** – Recording of actual aircraft overflight noise levels is mostly done as a routine matter only at airline airports and very busy, urban general aviation facilities. Data for smaller general aviation airports is rarely available unless a special study has been conducted for a particular purpose.

	DNL/CNEL = 65 dB	DNL/CNEL = 60 dB	DNL/CNEL = 55 dB
Criteria	• Set by the FAA and other federal agencies as level above which residential land uses may be incompatible if not acoustically treated. • Established by California state law as the maximum acceptable for residential and other incompatible land uses. • Schultz curve predicts that about 13% of the population will be highly annoyed at this noise exposure.	• The contour within which California Noise Insulation Standards require an acoustical analysis of proposed residential structures, other than detached single-family dwellings. • Suggested by the California Office of Noise Control as the maximum "normally acceptable" noise exposure for residential areas. • Individual noise events will occasionally cause significant interference with residential land use activities, particularly outdoor activities, in quiet suburban/rural communities. • Schultz curve indicates about 7% of population highly annoyed.	• Identified by the U.S. Environmental Protection Agency as the level below which "undue interference with activity and annoyance" will not occur. • Individual noise events will seldom significantly interfere with residential land use activities; commonly occurring noise events will not cause disruption under most circumstances. • About 4% of population highly annoyed at this noise level. • In urban areas, aircraft contribution to this level may be less than that of other noise sources.
Suggested Applicability	• Appropriate for airports in urban locations.	• Suitable for airports in suburban settings.	• Suitable for airports in quiet, rural locations.

Note: Economic and technical feasibility may need to be taken into account when setting criteria for individual airports.

Source: Hodges & Shutt (December 1993)

Table 7B

Residential Noise Compatibility Criteria Alternatives

- **INM Database** — The only other readily available source of data relating aircraft types to the single-event noise levels at various locations on the ground is the database for the Federal Aviation Administration's Integrated Noise Model. This database expresses single-event noise in terms of Sound Exposure Level (SEL).

Another factor which ALUCs should consider is that aircraft are frequently not the only source of loud single-event noises. Trucks and motorcycles, farm equipment, and various other noise sources are common in both urban and rural areas. Determining the relative significance of aircraft noise may be difficult.

Lastly, as discussed in Chapter 6, no definitive, widely recognized, single-event noise level guidelines currently exist. The single-event noise research which has been conducted has primarily focused on specific human reactions such as sleep disturbance. The means of applying such research to land use decisions is not yet clear.

Until single-event noise level guidelines evolve — assuming they eventually will — ALUCs have little solid grounds on which to base establishment of single-event noise level compatibility criteria. Any use of single-event noise level data should generally be limited to supplemental evaluation of special, highly noise-sensitive, land uses such as outdoor theaters.

Overflight Altitude

Single-event noise levels are often promoted as useful in identifying the existence of noise concerns in locations beyond those outlined by cumulative noise exposure contours. A less problematic alternative is to use the altitude of aircraft overflights (their height above ground level) as a means of defining the limits of these additional concerns. At least for general aviation airports, anecdotal information suggests a correlation between frequent, low-altitude aircraft overflights and noise-related annoyance. Such a measure also correlates with the fear and anxiety component of overflight annoyance noted in the previous chapter.

Interior Noise Level Criteria

One such guideline is a 45-dB L_{eq} noise level which the FAA considers as the "usual design objective" for sound insulation of schools. (FAA – 1989a)

The California Noise Insulation Standards, cited previously, set a CNEL of 45 dB as the maximum acceptable interior noise level for residential uses (other than detached single-family dwellings). Although guidelines for other uses exist, there are no other federal or state interior noise level regulations.

Problems arise with developing interior standards for other building uses because some are used only occasionally and others (such as concert halls) are especially sensitive to peak noises. The issue then is whether a cumulative average noise exposure measure (e.g., CNEL or DNL) is the most appropriate basis for compatibility standards. Some airport land use commissions have adopted peak noise level criteria for *intermittent* noises. However, application of these criteria poses questions in defining intermittent noise and in translating projected CNEL values into peak or maximum noise levels.

In light of these factors, ALUCs contemplating establishment of interior noise level criteria are advised to:

- Consider whether such criteria are necessary (in general, standard construction will provide adequate noise level reduction in areas where exterior noise levels are below 60-dB DNL/CNEL);
- Limit the applicability to residences, schools, and other equally noise-sensitive land uses; and
- Base the criteria on the CNEL metric unless data to support other measures can be documented.

Implications of Noise Mitigation Measures

In a pure sense, the acceptability of a given noise level with respect to a particular type of land use should solely be a function of the noise level and the land use. In practice, however, the presence of certain mitigating measures is usually deemed to modify the basic acceptability equation. These modifying conditions include the following.

Sound Insulation

Federal guidelines and California state regulations explicitly recognize the use of added sound insulation as a method of making normally unacceptable noise levels acceptable. Such measures are well-suited to land uses in which almost all noise-sensitive activities take place indoors. Sound insulation also is often the only option for improving existing incompatible conditions without changing the land use to one which is less noise sensitive.

However, the responsibility of airport land use commissions is with regard to proposed new land uses, not existing ones. *Rather than accepting the use of sound insulation as a mitigation action, ALUCs primary strategy should be to seek to prevent development of land uses which are basically incompatible with the noise conditions.* This strategy should especially be applied to single-family residential development and other land uses in which noise-sensitive outdoor activities are normal and important features.

Avigation Easements

Much the same concepts pertain to the use of avigation easements as do to sound insulation. They should not be a principal factor in ALUC policies for review of land use proposals involving noise-sensitive land uses in high-noise locations. The preferred compatibility policy should be to prohibit these uses.

A sample avigation easement document is included in Appendix D.

This is not meant to suggest that avigation easements are never appropriate. For airport proprietors, they are valuable alternatives to outright acquisition of existing, otherwise incompatible, land uses and are recognized as such by the FAA and in California state airport noise regulations. Avigation easements also are particularly useful as means of preventing intrusion of tall objects into airport airspace.

Buyer Awareness Measures

Buyer awareness measures such as those described in Chapter 5 do little to change the fundamental acceptability of high noise levels. However, in areas of low to moderate noise intrusion, they can be effective strategies.

The rationale behind the buyer awareness concept is that few people are highly annoyed by moderate noise — a maximum of 65 dB DNL/CNEL (or less depending upon the conditions). The intent, therefore, is to give people who may be annoyed by airport noise timely information with which to assess how living in an airport vicinity would affect them.

ALUC adoption of policies requiring local implementation of buyer awareness measures is strongly encouraged for all locations affected by frequent aircraft overflights.

The Context of Acceptability

A final point to be made on the topic of noise level acceptability is that what is acceptable depends in part upon the context — the nature of the proposed action being considered by the community. In this respect, noise contours and noise impact analyses serve two different functions: *promotion of compatible land use planning*; and *assessment of environmental impacts of proposed airport development.*

Land Use Compatibility

The noise metric function of principal importance to airport land use commissions is to prevent the development of noise sensitive land uses in locations where noise levels are significant. Most communities are able to develop a consensus of what constitutes an acceptable level of noise by considering the known existing noise conditions in the community. (By comparison, as noted below, community reactions to rapid changes in noise exposure which may be projected to result from a change in airport configuration or use are often more difficult to predict.) Proposed new land uses can then be evaluated against this acceptability criterion even if a gradual increase in the noise exposure is projected over the long term.

Balancing against this ideal concept of acceptability are the competing needs of community development. As examined in Chapter 3, various economic and social factors can shift the line of demarcation between acceptable and unacceptable noise exposure. ALUCs may need to reflect upon such factors when establishing noise compatibility criteria. In so doing, however, commissions should also remember that their primary responsibility is toward promoting compatibility between airports and proposed land use development in the airport vicinity. Local elected officials can weigh the importance of other factors if they so choose.

Environmental Impact Assessment

The other standard application of cumulative noise exposure metrics is to predict the effects of increased noise resulting from proposed or projected physical or operational changes at an airport. Addressing these anticipated effects is one of the functions of environmental impact documents prepared for airport-related projects.

As a guideline for considering when such changes might be significant and thus require thorough environmental impact review, the FAA has established a screening criterion. In noise-sensitive locations where the DNL already exceeds 65 dB, an increase of 1.5 dB is deemed the threshold of potential significance (FAA – 1986). The FICON report expands upon this screening concept by recommending that a projected increase of 3.0 dB within an area exposed to a DNL of 60 to 65 dB also be subject to analysis and possible mitigation.

Not reflected in these screening criteria is that noise increases of several decibels may also be significant in quieter environments (ones below DNL 60). Perhaps the most noteworthy example of this was the community reaction to flight track changes implemented by the Federal Aviation Administration in the New York/New Jersey area (the *Expanded East Coast Plan*). Even though the changes only affected air traffic patterns at altitudes above 3,000 feet and the resulting noise levels were still well below *acceptable* DNL levels, the adverse reaction from areas not previously affected by routine aircraft overflights was substantial.

One explanation for this reaction derives from the fact that most airport-related noise research has been conducted in areas which have long been exposed to substantial noise levels. People who live in these locations can be characterized as survivors — they are people who are unable to move away or they have in some manner adapted to the noise (Dunn – 1987). The data is not necessarily applicable as a predictor of the reactions of communities previously unexposed to frequent aircraft noise even if the new noise is relatively minimal.

Chapter 8

Aircraft Accident Characteristics

8

Aircraft Accident Characteristics

OVERVIEW

There has long been a general consensus within the airport industry that some degree of safety concern exists beyond the typical boundaries of an airport and its runway protection zones. This is particularly true with regard to general aviation airports which, compared to major airline facilities, typically control less land beyond the runway ends and have higher rates of aircraft accidents. Also, land use compatibility planning at most general aviation airports is not dominated by the extensive noise exposure areas common to airline airports.

The fundamental difficulty faced by airport and land use planners when attempting to develop safety compatibility criteria for the vicinity of airports is the lack of useful data. To be of value to land use planning, the locations of aircraft accidents need to be specifically plotted relative to the runway used. In a geographic sense, this data should be comparable to that available for aircraft noise exposure.

Neither the National Transportation Safety Board, which is the primary repository of aviation accident data in the U.S., nor the Federal Aviation Administration compile data in this manner. For both agencies, accidents are investigated for aeronautical purposes to determine ways of improving the design and operation of aircraft and airports and to foster better pilot skills and techniques. If land use factors are examined at all, it is done only in a manner incidental to the primary purpose of the investigation.

A major task in the preparation of this *Handbook* was the gathering of data on the precise location of aircraft accidents occurring in the vicinity of airports. The resulting accident database is summarized in this chapter. Also included here is information describing other characteristics of aircraft operations and accidents. Chapter 9 then evaluates this data in the specific context of airport land use commissions and safety compatibility planning issues.

The work of compiling the accident data was conducted by the Institute of Transportation Studies at the University of California, Berkeley. The research methodology is described together with some analysis of the data in a report entitled *The Development of An Accident Database to Structure Land Use Regulations in Airport Runway Approach Zones*. The major findings of this research report are incorporated into the discussion here.

AIRCRAFT LIMITATIONS AND PILOT ACTIONS

The emphasis in this discussion is on emergency conditions in which the aircraft can be maintained under at least some measure of pilot control. Most of the performance characteristics described here are not applicable in situations where the aircraft is incapable of being controlled (because of mechanical failure or damage resulting from collisions with obstacles or other aircraft, for example).

Chapter 6 outlined the parameters of normal operation of aircraft in the vicinity of airports. That discussion, presented in the context of airport noise, is also pertinent to safety compatibility issues in that it addresses where aircraft regularly fly. The additional factors of importance to the topic of safety are the performance limitations of aircraft and the actions of pilots which can cause or contribute to emergency situations. A review of these factors helps to provide some understanding of why aircraft accidents occur where they do.

Airplane Emergencies

Broadly speaking, aircraft operations emergencies can be divided into two groups: situations in which the pilot's control of the aircraft directly creates the emergency and situations in which some other condition causes an emergency to which the pilot must react. Among airport-vicinity airplane accidents in the first of these groups, the most common is pilot failure to maintain sufficient flying speed. This usually results in a stall and potentially a spin and uncontrolled descent. In the second group, common accident factors include adverse wind and weather conditions and loss of power (complete or partial engine failure for either mechanical reasons or due to lack of fuel).

Airplane Performance Limitations

When not prevented by mechanical or structural damage, the capability of an airplane to remain under pilot control while flying is largely dependent upon the plane's airspeed. Even in situations where an engine failure has occurred, a plane will not go out of control and drop from the sky if sufficient speed is maintained and enough altitude is available to give the pilot a chance to react. Most airplanes are capable of gliding 500 to 1,000 feet for every 100 feet of altitude (altitude is lost more quickly in turns than when gliding straight ahead, however). At a 1,000-foot traffic pattern altitude, for example, an airplane could travel one to two miles before reaching the ground.

One major difference among airplanes is between single-engine and twin-engine types. An obvious, but very important, distinction between the two is that a twin can experience an engine failure without having a complete loss of power. Although the asymmetrical thrust plus drag from the inoperative engine reduce performance to less than half, most large twins (particularly turbo-props and jets) can hold altitude or even continue to climb on one engine. For smaller twins with less power, the functioning engine may do no more than extend the glide distance, provided that the pilot keeps the aircraft under control.

For a single-engine plane, the critical airspeed is its *stall speed.* A twin-engine plane has two additional milestone speeds: *minimum control speed* and *best single-engine rate of climb speed*. These critical airspeeds are significant regardless of the flight mode of the aircraft: taking off, landing, or maneuvering at low speeds. As noted, however, these speeds are particularly important for a pilot to watch when an engine failure occurs, especially on takeoff.

- **Stall Speed (V_s)** — This is the minimum steady flight speed at which an airplane, either single- or twin-engine, can fly. At lower speeds, the flow of air over the wing does not generate enough lift to match the aircraft's weight. If an engine failure occurs before this speed is reached during the takeoff run, the airplane would remain on the ground and maximum braking should be applied to bring the plane to a stop. If the engine failure occurs while the airplane is airborne, it is essential for the pilot to keep the aircraft above stall speed. The airplane's speed can be controlled by adjusting its pitch and, on a twin, by use of the remaining engine. By staying above stall speed, an airplane can potentially be guided to a successful emergency landing. A significant factor to note is that an airplane's stall speed is higher during a turn (that is, it can stall more readily) than it is in straight flight.

- **Minimum Control Speed (V_{mc})** — Below this speed, a twin-engine airplane cannot be controlled with full power on one engine with the critical engine inoperative. Airflow across the rudder does not generate enough yawing force to overcome the asymmetrical thrust of a single engine operating away from the aircraft centerline. Engine failure below this speed requires a reduction in power on the good engine in order to maintain directional control. During a takeoff, the aircraft would either remain on the ground or would, if properly handled, return immediately to the ground in a controlled manner and maximum braking then applied (V_{mc} is typically attained while the aircraft is either still on the runway or only a few feet above it).

- **Single-Engine Climb Speed (V_{yse})** — V_{yse} is the speed at which a twin-engine airplane operating on one engine can attain the best rate of climb (or, for some aircraft, the slowest rate of descent). If an engine fails below this speed, it is possible to stretch a controlled descent as long as a speed of V_{mc} or better is maintained. The aircraft will quickly return to the ground, however. Engine failure at a speed above V_{yse} may not necessitate a forced landing because many aircraft are capable of using the remaining engine to climb to an altitude from which a return to the airport for a safe emergency landing can be made.

Pilot Actions

As alluded to above, pilot actions under emergency circumstances are a major determinant of whether an accident will result and, if so, how severe it will be. Pilots are taught a set of procedures to follow if, for example, an engine stops running. Most critical is to keep the aircraft under control. Next, time permitting, is to attempt to determine the problem and, if possible, restart the engine. If an emergency landing becomes inevitable, the pilot should then try to find a reasonable spot to put the aircraft down.

When an engine failure occurs while approaching or departing an airport, the initial reaction of most pilots is to attempt to land on the runway. If a landing traffic pattern is flown at a normal altitude and distance from the runway, a runway landing should be possible even in a single-engine airplane. On takeoff, however, the aircraft is headed away from the runway and a runway landing becomes difficult or, at low altitudes, impossible. As mentioned above, an airplane's descent rate and stall speed both increase while turning. This characteristic is the reason why a pilot's attempt to return to the runway following an engine failure at low altitude while on takeoff can have disastrous consequences.

In certain respects, maintaining control of a twin-engine airplane is more difficult following an engine failure than it is with a single-engine airplane. With the latter, a complete engine failure unavoidably results in descent (assuming the engine cannot be restarted) and the pilot has no choice but to respond accordingly. With a twin, however, many pilots think that they can keep the aircraft in the air even when an engine failure occurs on takeoff at low altitude. Many light twins, though, do not have enough power to continue to remain airborne on one engine. Moreover, because of a twin-engine airplane's asymmetrical thrust characteristics, lack of immediate and proper pilot response during an engine failure on takeoff is more likely to lead to an uncontrolled accident than is the case with a single-engine plane. For most twin-engine airplanes and most pilots, the prudent course of action if an engine fails at low altitude on takeoff is to reduce or shut off power to the good engine and glide back to the ground just like would be done in a single-engine plane.

In the few moments that a pilot may have available in which to select an off-airport emergency landing site, there is no certainty that the best site can be spotted — particularly at night or under IFR weather conditions — or that it can be reached. A large, flat, open area is preferable; but, if one cannot be found, a small open space or a street or parking lot are often the best candidates. Usually, an effort will be made to avoid people, buildings, large trees, and other such objects. Smaller objects, such as ditches and wires, may not be obvious until it is too late to avoid them. Luck consequently plays a significant role in such circumstances.

Helicopter Emergencies

As with airplanes, airspeed and altitude are also critical determinants of whether a pilot can maintain control of a helicopter in the event of an emergency involving an engine failure. Although helicopters cannot glide as far as airplanes can (a typical glide ratio at optimum airspeed is 300 to 500 feet horizontally per 100 feet of altitude lost), neither do they necessarily crash if an engine should fail while in flight. Indeed, because helicopters can safely descend much more steeply than airplanes, the area needed for an emergency off-airport landing can be much smaller. Also many of the newer, moderate-size helicopters — especially turbine-powered ones — have twin engines driving the main rotor.

The procedure used for emergency helicopter landings following an engine failure is known as autorotation. In simple terms, autorotation involves disengaging the main rotor from the engine drive system, thus enabling the blades to rotate freely. Air traveling upward through the blades causes them to continue rotating and producing lift to slow the descent. Also, the rotation of the main rotor drives the tail rotor to allow directional control to be maintained.

The altitude from which an emergency autorotation descent can successfully be conducted is dependent upon several factors with airspeed generally being the most significant. From near cruising speeds, most helicopters can perform an autorotation from an altitude of 100 feet or even slightly less. However, when hovering at zero airspeed, 500 feet of altitude may be needed. In effect, the altitude must be traded for forward speed before successul autorotation can be accomplished.

AVAILABILITY OF ACCIDENT LOCATION DATA

Historical Data

A vast amount of data on aircraft accidents is available from the National Transportation Safety Board (NTSB), the primary repository of aircraft accident data in the U.S., and from the Federal Aviation Administration. As noted at the beginning of this chapter, however, data regarding the location of aircraft accidents is scarce.

Approximate Location Data

For each accident which the National Transportation Safety Board investigates, a *Factual Report* (NTSB Form 6120.4) is completed. Included in the report are data entries for *distance from airport center* and *direction from airport*. This information could be valuable for land use compatibility planning purposes if it were precisely calculated. Its usefulness is limited, however, because the accident investigation form requires only that the data be given to the nearest statute mile.

A compilation of the NTSB accident proximity data for the years 1974 through 1981 is shown in Figure 8A.

The NTSB has not published this information for later years in its *Annual Review of Aircraft Accident Data*. Nevertheless, the consistency of the numbers for the years examined suggests that the average remains basically valid today.

The data reveals that nearly half (47%) of all aircraft accidents take place on an airport. Another 30% are en route accidents – defined here as ones occurring more than 5 miles from an airport. This leaves 23% of all accidents which can be classified as airport-vicinity accidents, potentially including some en route accidents which happened to take place within 5 miles of an airport.

Precise Location Data

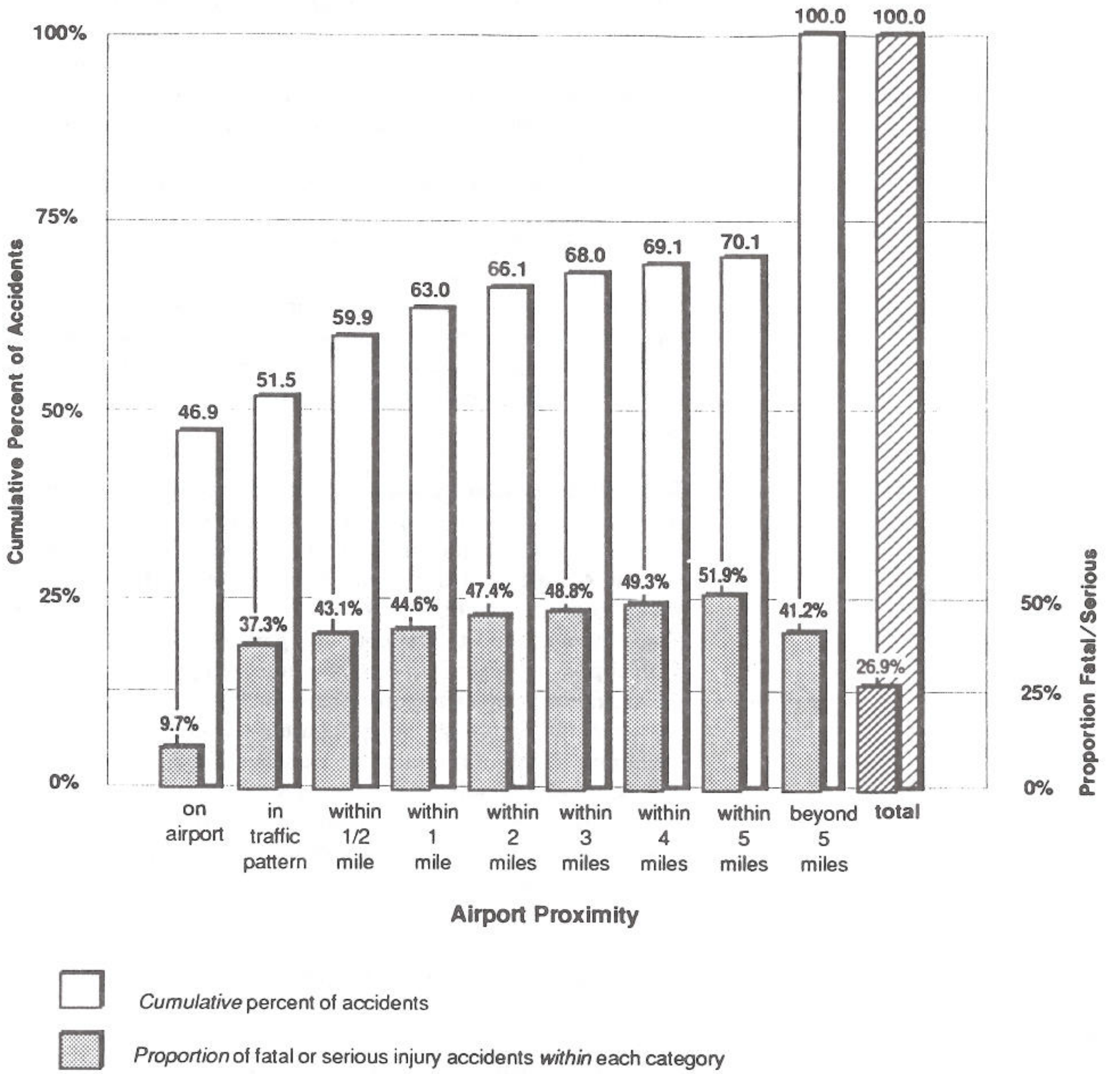
Several previous research efforts have endeavored to document the type of precise aircraft accident location data which would be pertinent to airport land use compatibility planning. Although each of the studies provides significant information, all are limited in scope.

- **Report of the President's Airport Commission** – This commission, best known as the Doolittle Commission in honor of its chairman, James Doolittle, conducted one of the first comprehensive studies of the noise and safety relationships between airports and surrounding communities. The commission's 1952 report is valuable today for the historical perspective it gives to current airport compatibility issues. Among other things, the commission plotted the location of over 30 off-airport commercial and military aircraft crashes which caused death or injury to persons on the ground (there is no indication in the report that any data was gathered regarding non-injury accidents). Despite the rather limited database, the commission's report lead to the establishment of what became known as clear zones and are now called runway protection zones at the ends of airport runways.

See Chapter 9 for a description of APZs.

- **Department of Defense Air Installation Compatible Use Zone (AICUZ) Program** – The AICUZ program was established in 1973 as a joint effort of the several branches of the military. An element of the study leading to the creation of the program entailed assembly and analysis of data regarding the locations of military aircraft accidents around air bases. The data covered the period from 1968 through 1972 and included more than 300 major airfield-related accidents which occurred within 10 nautical miles of the runway. The study served to define areas of significant military aircraft accident potential, known as *Accident Potential Zones (APZs).*

- **FAA Commercial Aircraft Accident Study** – A 1990 FAA study (*Location of Aircraft Accidents/Incidents Relative to Runways*) com-



Source: NTSB Annual Review of Aircraft Accident Data: U.S. General Aviation - Calendar Years 1974-1981 (Data is not published in this format for later years)

Source: NTSB Annual Review of Aircraft Accident Data: U.S. General Aviation – Calendar Years 1974-1981 (Data is not published in this format for later years)

Figure 8A

Proximity of General Aviation Accidents to Nearest Airport

piled data regarding the location of commercial aircraft accidents relative to the runway involved. Data was gathered by review of National Transportation Safety Board dockets containing the complete record of the board's investigation of each accident. A total of 246 accidents and incidents occurring over a 10-year period (1978-1987) were included in the analysis. Of these, the majority (141) were limited to the immediate vicinity of the runway. Some 87 were classified as being either: a landing accident/incident in which the aircraft impacted with the ground more than 2,000 feet from the runway threshold; or a takeoff crash after the aircraft became airborne, but before it reached the first power reduction or VFR pattern altitude. Another 18 entries were landing undershoots occurring within 2,000 feet of the runway end. Figure 8B depicts the locations of the 16 landing (including 4 undershoots of more then 500 feet) and 23 takeoff accidents/incidents for which adequate locational data was available.

- **Reid-Hillview Airport Land Use Safety Compatibility Study** — Another recent study which sought to pinpoint the location of aircraft accidents was one conducted by Hodges & Shutt for the Santa Clara County Airport Land Use Commission in 1991. The study was limited in scope to airports similar in character and level of activity to Reid-Hillview Airport. The data was gathered through direct contact with airport managers. In total, the research plotted the location of 70 accidents from 14 airports (Figure 8C). The location of crash sites for accidents occurring during departures were plotted relative to the departure (climb-out) end of the runway; no adjustment was made for the varying lengths of the runways (the runway lengths ranged from 2,500 to 8,000 feet, with the median being about 3,100 feet). The crash sites for arrival accidents were plotted with respect to the intended landing runway.

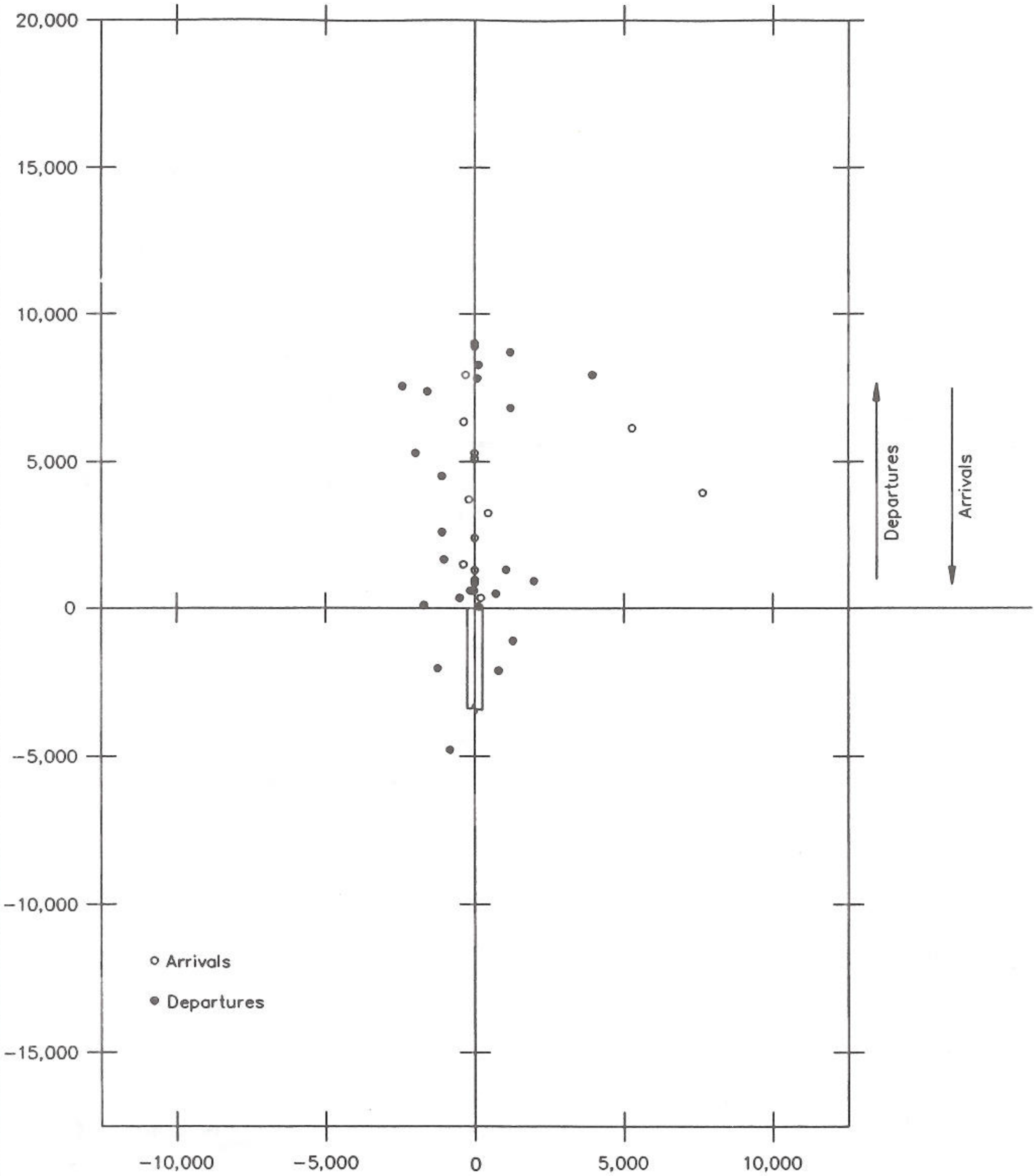
Theoretical Areas of High Accident Probability

Particularly useful in this regard is data on the phase of operation of aircraft at the time of an accident. Table 8A contains a summary of published NTSB data on this subject.

By examining the available data on types and locations of accidents in conjunction with information on airplane operational parameters as discussed earlier, it is possible to ascertain where accidents can theoretically be expected to occur most often.

Approach/Landing Accidents

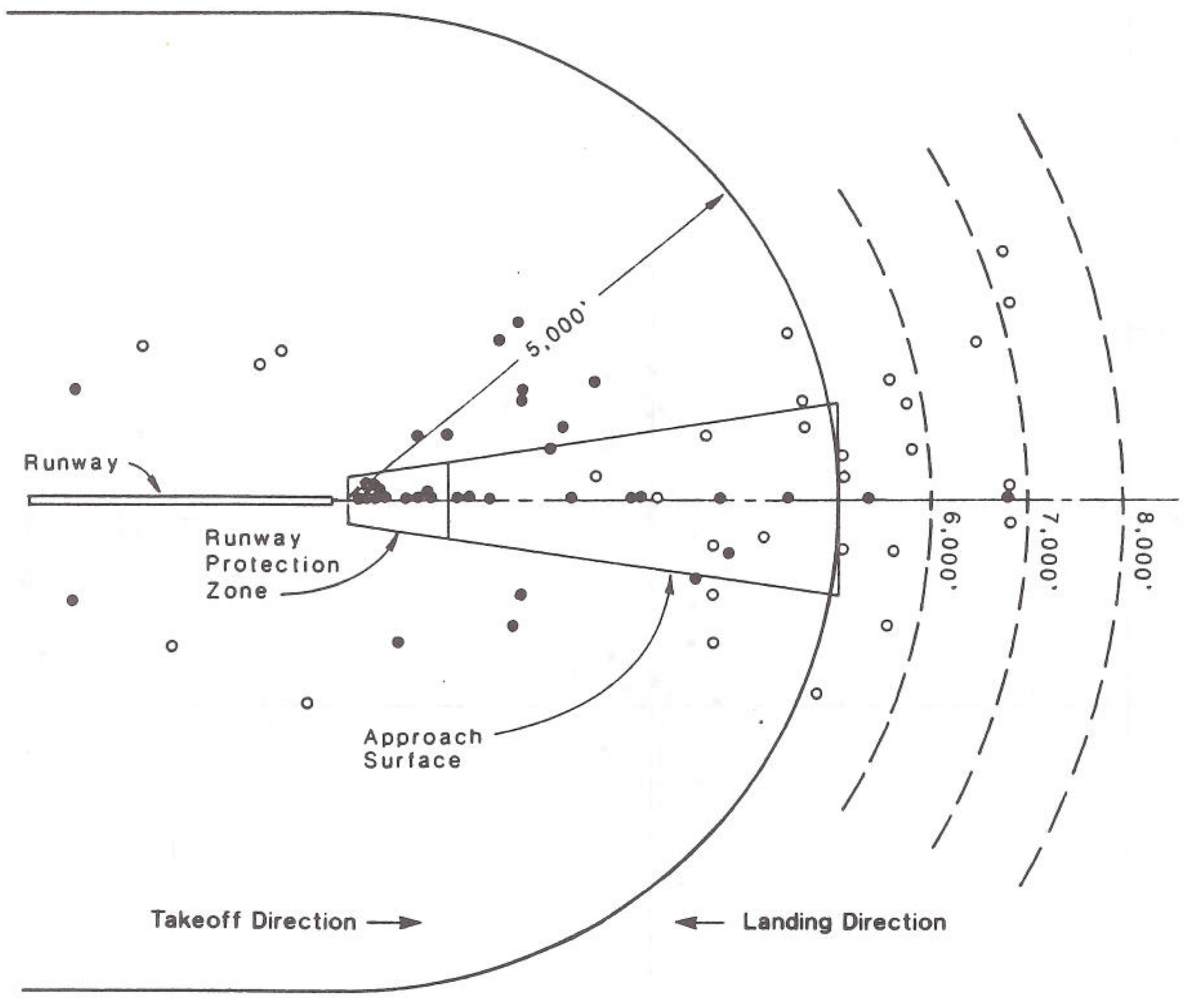
The great majority of aircraft landing accidents take place on or immediately adjacent to the runway. Indeed, NTSB data indicates that some two-thirds of all landing accidents occur during touchdown or roll-out (usually hard or long landings, ground loops, etc.). Although frequent in occurrence, these types of accidents seldom (less than 5% of the time) result in serious or fatal injuries.



Source: FAA Office of Safety Oversight (1990)

Figure 8B

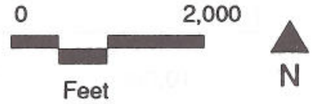
Commerical Aircraft Accident Location Pattern



○ Accident site - Takeoffs

● Accident site - Landings

Note:
- Data compiled from 14 general aviation airports
- Runway protection zone and approach surface assumes a nonprecision approach to a utility runway



Source: Hodges & Shutt (1991)

Figure 8C

Aircraft Accident Locations at Selected General Aviation Airports

Phase of Operation	Percent of Total		Proportion Fatal/Serious	
Standing	0.9		41.0	
Taxi	3.2		4.1	
Takeoff				
Run		4.6		6.7
Initial Climb		13.1		32.8
Other		2.2		16.8
Total	19.9		25.0	
In Flight				
Climb		2.5		42.8
Cruise		14.4		37.0
Descent		4.0		58.7
Maneuver		13.9		49.0
Total	34.8		45.1	
Landing				
Pattern		2.9		45.7
VFR Final		6.0		27.7
IFR Initial/Final		1.0		70.0
Touchdown		13.5		7.3
Roll		12.2		2.6
Go-Around		2.5		31.7
Other		1.8		22.5
Total	40.0		15.5	
Other/Unknown	1.2		67.9	
ALL ACCIDENTS	100.0		28.2	

Note: Data includes all U.S. general aviation accidents by all aircraft types for the period 1974–1989.

Source: Data compiled from *NTSB, Annual Review of Aircraft Accident Data — General Aviation 1974-1989*

Table 8A

Accidents by Phase of Operation

U.S. General Aviation

Of the remaining landing accidents, more than half take place on final approach. A common circumstance that can result in an approach accident is pilot misjudgment of the aircraft descent rate and failure to add power soon enough to keep the aircraft in the air. Poor visibility, unexpected downdrafts, or tall objects beneath the final approach course can intensify this problem. Another prospective type of landing accident can occur if a pilot overshoots a turn from base to final and inappropriately cross controls the airplane rudder and ailerons while attempting to return to the runway alignment. The result can be a stall, spin, and uncontrolled crash.

These types of events all will tend to place the accident site fairly close to the extended runway centerline. Also, because lower altitude decreases the chances of successful recovery from unexpected conditions, accidents can be expected to be more common closer to the runway end than at points farther away.

Takeoff/Departure Accidents

Historical data indicates that the greatest proportion of takeoff/departure accidents – some 65% – take place during the initial climb phase. This finding is consistent with two factors:

- Aircraft engines are under maximum stress during the initial climb phase and thus somewhat more susceptible to mechanical problems than at other times; and
- Secondly, on average-length runways, once an aircraft has begun to climb, it is often too late to make an emergency landing and stop on the runway without overshooting the far end.

With respect to where takeoff accidents occur, a much greater dispersion of sites can be hypothesized than is the case for landings. Landings all involve aircraft descending at similar angles toward about the same point on the runway. By comparison, more variables affect the three-dimensional path of aircraft takeoffs, even under normal conditions. For one, climb rates and other takeoff performance characteristics differ substantially from one aircraft type to another. Also, even for similar types of aircraft, the flight track and the altitude above any given point along it will vary depending upon the aircraft payload, piloting techniques, and the intended direction of flight after takeoff.

The differences in performance characteristics of single-engine versus twin-engine propeller airplanes is particularly illustrative.

- **Single-Engine Airplanes** – For single-engine airplanes, a high percentage of accidents can be expected to occur within 7,000 to 9,000 feet of the start of takeoff roll. This distance is calculated based upon an assumed occurrence of an engine failure at an altitude of 500 feet with the aircraft then gliding back down to the ground (and also assuming the ground level to be equal to that of the airport). As previously discussed, at altitudes above 500 feet, it is possible to return to the runway for an emergency landing and most pilots will attempt to do so rather than continue straight ahead. At lower altitudes, the most prudent pilot action is to seek a landing site as close to straight ahead as practical.

- **Twin-Engine Airplanes** – With a twin-engine airplane, an engine failure on takeoff does not necessarily mean that the aircraft will immediately glide back toward the ground. The altitude at engine failure and the manner in which the remaining engine is operated thus add more variables to where the plane can be most expected to put down. If an engine failure occurs at or below best single-engine rate of climb speed (V_{yse}), the aircraft would normally be just airborne and controllable, but sometimes unable to climb. At these low speeds, the proper pilot action should be to reduce or shut off power to the remaining engine and glide back to the ground as would a single-engine airplane. At speeds slightly above V_{yse}, twin-engines airplanes may theoretically be capable of climbing, but for a pilot to make this happen under emergency conditions is difficult. Sometimes, a pilot will try to maintain power in the functioning engine, but then lose directional control of the aircraft and crash. A relatively wide dispersal of accident sites – both in distance from the start of takeoff and to either side of the extended runway centerline – can thus be predicted in theory.

New Research

See Appendix B for a more complete description of the data sources considered, the research methodology employed, and the specific data included in the database.

In order to obtain the precise airport-vicinity accident location data deemed highly important to the purposes of this *Handbook*, basic new research was concluded to be necessary. After investigating several possible data sources – principally direct contact with individual airports versus review of the NTSB *Factual Reports* – the latter method was found to provide the most complete and consistent data. The research was conducted by the Institute of Transportation Studies, at the University of California, Berkeley.

The database which has resulted from this research:

- Encompasses all 50 states;
- Covers a time period from 1983 into 1991;
- Contains data only on accidents, not incidents;
- Contains a total of 400 aircraft accident records (190 arrivals and 210 departures); and

- Includes all types of general aviation airplanes, but not airline aircraft, helicopters, or other aircraft types (ultralights, blimps, etc.), or military aircraft.

A somewhat broad definition of airport vicinity was used for the purposes of this research. Airport size was recognized as being a significant determinant of whether an accident site a certain distance beyond the runway is on or off the airport property. Consequently, all accidents not confined to the immediate vicinity of the runway or its associated safety zones are included in the database. For the outer boundary of the airport vicinity, a 5-mile radius — measured from the airport center in accordance with the NTSB data format — was selected.

AIRCRAFT ACCIDENT LOCATION PATTERNS

All of the accident location pattern exhibits noted in this section can be found at the end of this chapter.

The following paragraphs highlight notable findings from the current research. Comparative data from other sources is indicated where applicable. Table 8B presents a numeric summary of the percentages of various categories of accidents represented in the database. Selected distance data is listed in Table 8C. Table 8D summarizes some comparative accident data for all U.S. general aviation aircraft accidents, both on-airport and off.

Arrival versus Departure Differences

See Appendix B for the criteria used to distinguish between arrivals and departures for circumstances such as touch-and-goes and missed approaches.

The first question assessed in review of the accident location data was to determine how the pattern of aircraft landing accidents differs from the pattern for takeoff accidents. An important issue in this analysis is what point to use as a common reference within each of these accident categories.

- **Arrivals** — For landing accidents, this decision is easy. The landing threshold, whether it be the actual runway end or a displaced threshold, is the relevant point. Exhibit 8A illustrates the spatial distribution of all arrival accidents occurring within 25,000 feet of the runway landing threshold.

As used herein, the departure end of the runway is the end which the aircraft passes on takeoff and climb-out.

- **Departures** — For takeoffs, two choices of common reference point are apparent: the beginning point of the takeoff roll and the departure end of the runway. Except for touch-and-goes and intersection departures, the runway length represents the difference between the two points. Each of these choices has theoretical merits as to the utility of the information provided.
  - Measuring from the start of takeoff roll recognizes the fact that, once an aircraft is airborne, the location of many accidents is independent of the runway length.

Category Accidents Involving:	All Accidents		Arrival Accidents		Departure Accidents	
Total Database	400	100.0%	190	100.0%	210	100.0%
Aircraft Type						
Single-Engine Propellor	289	72.3%	125	65.8%	164	78.1%
Twin-Engine Propellor	109	27.3%	63	33.2%	45	21.4%
Business Jet	2	0.5%	2	1.1%	1	0.5%
Time						
Dawn	2	0.5%	1	0.5%	1	0.5%
Day	262	65.5%	97	51.1%	165	78.6%
Dusk	17	4.3%	14	7.4%	3	1.4%
Night	119	29.8%	78	41.1%	41	19.5%
Weather Conditions						
VFR	299	74.8%	122	64.2%	177	84.3%
IFR	101	25.3%	68	35.8%	33	15.7%
Approach Type						
Visual Approaches			128	67.4%		
Non-Precision Approaches			15	7.9%		
Precision Approaches			45	23.7%		
Pilot Control						
Some	121	30.3%	58	30.5%	63	30.0%
None	234	58.5%	109	57.4%	125	59.5%
Unknown	45	11.3%	23	12.1%	22	10.5%
Inflight Collision with Object						
Yes	165	41.3%	87	45.8%	78	37.1%
No	235	58.8%	103	54.2%	132	62.9%
Aircraft Damage						
Destroyed	297	74.3%	143	75.3%	154	73.3%
Substantial	96	24.0%	45	23.7%	51	24.3%
Consequences						
Onboard Fatalities	234	58.5%	108	56.8%	126	60.0%
Ground Fatalities	4	1.0%	2	1.1%	2	1.0%
Onboard Serious Injury	109	27.3%	54	28.4%	55	26.2%
Ground Serious Injury	5	1.3%	2	1.1%	3	1.4%
Traffic Pattern Direction						
Left	179	44.8%	91	47.9%	88	41.9%
Right	24	6.0%	12	6.3%	12	5.7%
Unknown	197	49.3%	87	45.8%	110	52.4%
Runway Length						
Less than 4,000 ft.	157	39.3%	61	32.1%	96	45.7%
4,000 ft. to 5,999 ft.	127	31.8%	62	32.6%	65	31.0%
6,000 ft. or more	116	29.0%	67	35.3%	49	23.3%

Note: Numbers in each category may not add to 100% because of mathematical rounding or missing data in some records.

Source: Data compiled by Hodges & Shutt (December 1993)

Table 8B

Accident Characteristics - Proportions

Handbook Database

	Mean Distances (Feet)			
	All Operations	Arrivals	Departures	Normalized Departures
Runway Length				
All Categories	4,940	5,380	4,540	
Swath Length				
All Categories	230	280	170	
Pilot Control				
Some	240	270	220	
None	190	240	130	
Accident Location				
All Categories		3,390	5,780	1,240
Aircraft Type				
Single-Engine		2,540	5,060	990
Twin-Engine		5,080	8,330	2,160
Pilot Control				
Some		2,700	5,060	770
None		3,710	6,100	1,360
Visibility				
VFR		2,270	5,490	1,210
IFR		5,410	7,320	1,420
Time of Day				
Dawn/Daylight/Dusk		2,600	5,280	980
Night		4,540	7,820	2,320

	Median Distances (Feet)			
	All Operations	Arrivals	Departures	Normalized Departures
Runway Length				
All Categories	4,660	5,000	4,200	
Swath Length				
All Categories	130	160	100	
Pilot Control				
Some	150	160	140	
None	100	150	70	
Accident Location				
All Categories		1,650	4,940	880
Aircraft Type				
Single-Engine		1,260	4,090	770
Twin-Engine		3,330	7,490	1,600
Pilot Control				
Some		1,350	4,750	770
None		1,790	5,000	790
Visibility				
VFR		1,030	4,430	770
IFR		3,980	8,430	1,900
Time of Day				
Dawn/Daylight/Dusk		1,010	4,450	770
Night		3,660	6,460	1,460

Notes:
- All distances rounded to nearest 10 feet.
- Accident location distances calculated along runway centerline, ignoring offset to left or right. Arrival distances measured from landing threshold; departure distances from start of takeoff roll; normalized departure distances from departure (climb-out) end of runway.

Source: Data compiled by Hodges & Shutt (December 1993)

Table 8C

Accident Characteristics — Distances

Handbook Database

	Percent of Total Accidents	Proportion Fatal/Serious
Time of Day		
Dawn/Daylight/Dusk	89.1[b]	24.2[a]
Night	10.9	46.9
Weather Conditions		
VFR	91.9[b]	22.8[a]
IFR	8.1	67.4
Aircraft Damage		
Destroyed	28.0[c]	
Substantial	70.8	
Minor/None	1.2	
Type of Injuries		
Fatal	17.8[c]	
Serious	10.8	
Minor/None	71.4	
Aircraft Type		
Single-Engine Airplanes	80.0[d]	27.8[d]
Twin-Engine Airplanes	9.3	37.5
Business Jet	0.5	33.8
Helicopter	7.5	27.6
Other	2.8	52.6

Note:

- Comparable data not available for all years. Data shown is tablulated for the following years:

  [a] 1974-1979 [c] 1977-1989
  [b] 1974-1985 [d] 1980-1989

- Data includes all general aviation accidents, both on- and off-airport.

Source: NTSB, Annual Review of Aircraft Accident Data — General Aviation 1974-1989

Table 8D

Selected NTSB Accident Data

U.S. General Aviation

- On the other hand, circumstances resulting in an accident 2,000 feet beyond the end of a 5,000-foot runway might result in nothing more than an emergency landing on a 10,000-foot runway. *Normalizing* the data by measuring from the departure end of the runway thus takes into account the significance of runway length in many departure accidents.

Exhibits 8B and 8C show the distributions measured in terms of each of these reference points. As can be expected, the clustering of points is much tighter when measured from the departure end of the runway.

The total number of accidents in the database is split almost equally between arrivals and departures. By comparison, NTSB data indicates that landing accidents occur about twice as often as takeoff accidents (Table 8A). The substantial number of landing accidents which take place on or near the runway accounts for most of this difference.

Effects of Runway Length

Another means of factoring out the runway length variable for departure accidents is to individually assess the location distributions associated with different length runways. Exhibits 8D, 8E, and 8F illustrate the results for runway lengths of less than 4,000 feet, 4,000 to 5,999 feet, and 6,000 feet or more, respectively. The sites of the departure accidents are plotted with respect to the start of takeoff roll.

One finding apparent from these illustrations is that the longer the runway, the greater the spread of departure accident locations. Nevertheless, the locations tend to be most closely bunched around the end of the median length runway in each of these groups.

Another, perhaps somewhat surprising, variable revealed by the three charts is that arrival accidents also are more spread out for longer runways than for shorter ones. A review of the data suggest several possible explanations for this phenomenon:

- Almost half (47%) of all accidents on runways of 6,000 feet or more are by twin-engine aircraft compared to only 8% on runways under 4,000 feet.
- Long runways have more IFR accidents – 43% for runways of 6,000 feet or more, 12% for runways of less than 4,000 feet.
- Similarly, for nighttime accidents, more occur on long runways (48%) than on short ones (16%).

Aircraft Type Variables

Single-Engine Propeller Airplanes

Not certain from the accident records is whether accident locations reported as being on the extended runway centerline might actually be several hundred feet off to the side, especially for accidents occurring some distance from the runway end. It is apparent from NTSB reports that precision in terms of accident site location was not a high-priority objective. Every effort was made in the review of the records to determine the accident location as precisely as possible, but the actual number of points truly on centerline is probably less than shown in the database.

Exhibit 8G illustrates the pattern of off-airport landing and takeoff accidents by single-engine propeller airplanes. As hypothesized above, the accident locations tend to be clustered close to the runway ends and also relatively near the extended centerline. For approach/landing accidents, the median distance is 1,260 feet from the landing threshold. For takeoffs/departures, the median distance is 770 feet from the departure end of the runway and 4,090 feet from the start of takeoff roll. Also, almost 90% of the departure accident points lie within 9,000 feet of the start of takeoff roll.

Multi-Engine Airplanes

The database indicates that the accident locations for twin and other multi-engine airplanes, including jets, are comparatively more stretched out than those for single-engine airplanes. Exhibit 8H depicts the distribution. The majority of the approach/landing accidents are within 500 feet of the extended runway centerline, but the median distance is more than 3,300 feet from the landing threshold. The takeoff/departure accidents are widely scattered as conjectured in the earlier discussion of aircraft and pilot performance during emergencies. Although the median accident site distance is some 1,600 feet from the departure end of the runway, the sites are spread about evenly in the 5,000 to 10,000-foot range measured from the start of takeoff roll.

Airline Aircraft

The project database does not include airline aircraft accidents. For an assessment of these accidents, reference should be made to the FAA commercial aircraft accident study cited earlier in this chapter.

Helicopters

Helicopter accidents were not included in the *Handbook* database because of helicopters distinctly different operational characteristics compared to those of airplanes. Data comparable to that presented here for airplanes may exist in NTSB *Factual Records*, but has not been compiled in any published source.

The most detailed recent assessment of helicopter accident locations is one documented in two reports prepared for the Federal Aviation Administration – *Analysis of Helicopter Mishaps at Heliports, Airports, and Unimproved Sites* and *Analysis of Helicopter Accident Risk Exposure near Heliports, Airports, and Unimproved Sites* (Systems Control Technology –

1991 and 1992). This study found that (between 1977 and 1986) some 37% of helicopter accidents took place on or within 1 mile of a landing site whether it be at an airport, a heliport, or other location. Among all types of helicopter mishaps (accidents plus incidents), 60% involved obstruction strikes – 38% at the landing site and 22% within 1 mile. The majority of the latter group were wire strikes and in each case the wires were unmarked. This finding lead the authors of the study to recommend the marking of wires and other objects within a buffer zone below the standard 8:1 approach/departure surface slope of helicopter facilities.

Three additional observations are worth noting regarding helicopter accident locations:

- Because helicopter landing sites are small, a substantial proportion likely occurs, or affects locations, beyond the landing site boundaries.
- Helicopters can take off and land in almost any direction from a heliport, obstacles and wind direction permitting.
- Beyond the immediate vicinity of the landing site, helicopter flight tracks may be widely divergent unless specific procedures are established for a given airport or heliport.

Pilot Control Variables

In the discussion of emergency procedures earlier in this chapter, the point was made that a pilot will, if possible, normally attempt to steer the aircraft to an open area when an emergency landing is unavoidable. A general assumption has been that most aircraft are under some control when forced down. The extent of pilot control was therefore one of the variables assessed in the review of the accident Factual Records.

The results of the research were surprising: in over half of the cases included in the database, the aircraft was not under control when it hit the ground. A probable explanation for this number being so high is that the database includes only accidents, not incidents. Thus, if a pilot makes a successful emergency landing without causing serious injuries or substantial damage, the event is classified as an incident and does not appear in NTSB records even if the landing site is not an airport runway.

Exhibits 8I and 8J show the location patterns for accidents in which there was *some pilot control* and *no pilot control*, respectively. For both arrivals and departures, the *some pilot control* accidents are more tightly clustered near the runway. This pattern suggests that the pilots have made some attempt to reach the airport, perhaps landing in a nearby open area.

Other Variables

Weather Conditions

Exhibits 8K and 8L show the respective distributions of accidents which took place during visual flight rules (VFR) weather conditions versus those occurring during instrument flight rules (IFR).

A comparison of the two figures indicates that IFR arrival accidents tend to occur farther from the end of the runway than VFR accidents do — a median distance of nearly 4,000 feet from the runway approach end for IFR arrivals versus 1,000 feet for VFR landings. However, for accidents within 2,500 feet of the landing threshold, IFR crash sites appear more likely to be significantly offset from the runway alignment than is the case with VFR accident locations. This propensity for close-in deviation from the runway centerline probably reflects accidents which occur during circling or missed approaches. The database includes too few IFR departure accidents to enable conclusions to be drawn.

It is noteworthy that the *Handbook* database includes a higher percentage of IFR accidents (25%) than occurs among all general aviation accidents (8% — see Tables 8B and 8D). This disparity can be accounted for by the fact that on-airport accidents, the preponderance of which occur under VFR conditions, are excluded from the database.

Time of Day

NTSB data reveals that approximately 89% of all general aviation accidents take place during dawn, daylight, or dusk, with about 11% occurring in hours of darkness (officially, one hour after sunset to one hour before sunrise). No definitive data is available on the percentage of all aircraft takeoffs and landings made at night, but a reasonable estimate is 7% to 10%. Considered together, these figures indicate that the nighttime accident rate is greater than the daytime rate, but not substantially so.

Of all the accidents in the *Handbook* database, approximately 30% took place at night. Moreover, nighttime accounted for over 40% of the arrival accidents in the database. If these figures are representative of all off-airport accidents, they suggest that nighttime increases the propensity for accidents to occur beyond the runway environment. Exhibits 8M and 8N show the locational distributions of dawn/daylight/dusk versus nighttime accident sites. As can be seen, the nighttime accident sites are generally farther from the runway than are the daytime accident sites — the median is some 2,600 feet greater for arrivals and 700 feet more for departures.

NATURE OF IMPACT

The nature of the impact that occurs when a small aircraft comes down off airport can vary from a nearly normal landing to a catastrophic crash. When the aircraft remains under control and a reasonably open emergency landing site can be found, the impact can be relatively minor — the potential for injury to people on the ground is small and the aircraft occupants have a strong probability of surviving. The most serious accidents, in terms of risks to people on the ground as well as to the aircraft occupants, are those in which the pilot either:

- Loses control of the aircraft and, because of damage, low altitude, or improper procedures, is unable to regain control; or
- Is unable to select a reasonable forced landing spot because of darkness, fog, or the nonexistence of such a spot.

The following discussion examines available data and theoretical findings regarding the nature of the impact from an aircraft accident.

Severity

As can be expected, off-airport aircraft accidents tend to be more severe than those occurring on or near a runway. The accident database summary (Table 8B) indicates that the aircraft is destroyed in some 75% of off-airport accidents. Moreover, fatal injuries occur more than half of the time — 57% for arrival accidents and 60% for departure accidents. By comparison, NTSB data (Table 8D) shows that for all accident locations, the rates for destroyed aircraft and fatal injuries have been only 28% and 18%, respectively.

It must be remembered, however, that these figures are relative to the total number of *accidents*. No information is available regarding how often aircraft make an emergency landing on or off of an airport without incurring substantial damage or resulting in serious or fatal injuries. Nevertheless, the percentage involving severe consequences is undoubtedly much less when all mishaps (incidents as well as accidents) are taken into account.

Darkness and poor weather both adversely affect the severity of accidents. According to NTSB data, less than 25% of dawn/daylight/dusk accidents involve serious or fatal injuries, compared to nearly 50% of the night accidents. Likewise, IFR accidents have serious or fatal results some two-thirds of the time, whereas less than a quarter of VFR accidents have such severe consequences.

Swath length is defined as the distance between where an aircraft first touched the ground or an object on the ground and where it subsequently came to a rest.

Accident Swath

One of the variables examined during the review of NTSB accident records was the swath length associated with each accident. Adequate information with which to assess this factor was available in only about 60% of the Factual Records. Among the conclusions reached regarding the accidents represented in the database are:

- The median swath length for all accidents is approximately 130 feet.
- Accidents in which the aircraft was under some pilot control typically have longer swath lengths (150 feet on average) than those where the aircraft was out of control (100 feet average).

Accidents Involving Collisions with Objects

Aircraft collisions with objects on the ground can be the cause of accidents or simply a secondary factor in the consequences of the event. The NTSB's annual reviews of general aviation accident data include counts of accidents in which objects were a cause or factor, although the format and content of the data changes every few years. Table 8E presents a summary of this data.

In evaluating the data's significance, several points should be recognized:

- The data includes accidents involving all types of aircraft helicopters, hot air balloons, etc.), not just airplanes.
- The location of the objects involved may be either on or off airport.
- The counts include accidents during all phases of aircraft operation — taxiing accidents, as well as those during approaches, departures, or en route.
- No distinction is made between accidents in which the objects listed were the cause versus ones in which they were only involved in a secondary manner.
- The severity of the accidents is not reflected by the data.

A particularly noteworthy finding of the data is the rarity of accidents involving residences or other buildings. For an 8-year period (1982-1989), the annual average was only 8.1 and 9.9 per year for residences and other buildings, respectively. An earlier study by the Aircraft Owners and Pilots Association (AOPA – 1985) for the years 1964-1982 showed a higher average number of collisions with residences and other buildings — a total of 29.6 per year (also summarized in Table 8E). However, more aircraft operations, as well as nearly 65% more accidents, took place annually during that period compared to the more recent data. The percentage of annual accidents involving residences and buildings thus averages only about 0.65% in both data sets. The results of the accidents included in the database are consistent with the NTSB data. Only 1 accident of the 400 in the database involved a collision with a residence and only 11 involved other buildings. (Again, remember that the *Handbook* database excludes accidents confined to the immediate runway environment.)

Effects of an Aircraft Collision with a Building

As part of a previous research study (Hodges & Shutt – 1985), data was gathered regarding the probable effects of a small aircraft colliding with a typical house or other small building. The research entailed a search for previous studies on the subject, review of historical accident records, and interviews with building demolition experts and aircraft salvage companies. Consideration was also given to what effects might theoretically be predicted.

Variables

The consequences of an aircraft collision with a building were found to be affected by many variables. Among the primary ones are:

- The aircraft weight.
- The amount of fuel on board.
- The speed of the aircraft, both horizontally and vertically, at the time of the collision.
- The angle of contact with the structure (i.e., glancing or head-on).
- The aircraft attitude when the collision occurs.
- The composition of the building surface struck by the aircraft.
- The occurrence of fire after the impact.

Conclusions

The study determined that the combination of these variables is so great as to preclude definitive conclusions. The effects can only be estimated within a wide range of possibilities. To the extent that any meaningful conclusions can be reached from the data obtained, they can be summarized as follows:

- **Significance of Aircraft Size** — Other factors being equal (which, for any two accidents, they never are), more damage will be produced by larger, faster aircraft than by smaller and slower ones. The amount of kinetic energy produced by a small, but fully loaded,

	Average Number/Year	% of Category	% of All Accidents
Accidents Involving Objects on the Ground (1982-1989)[a]			
Type of Object Involved			
Residences	8.1	1.4	0.3
Other Buildings	9.9	1.7	0.4
Fences/Walls	88.0	15.1	3.2
Poles/Towers	26.4	4.5	1.0
Wires	108.3	18.6	3.9
Trees	242.5	41.7	8.8
Other Objects	98.3	16.9	3.6
Total - All Objects	581.4	100.0	21.2
All Accidents	2,742		100.0
Accidents Involving Buildings and Residences (1964-1982)[b]			
Phase of Flight			
On-Ground	9.1	30.8	0.20
Traffic Pattern	17.8	60.1	0.40
In-Flight	2.7	9.1	0.06
Total	29.6		
Type of Injuries On-Board or On-Ground			
Fatal	3.7	12.5	0.08
Serious	4.4	14.9	0.10
Minor/None	21.5	72.6	0.48
Total	29.6	100.0	0.66
Type of Injuries to People On-Ground			
Fatal	0.5	27.8	0.011
Serious	0.6	33.3	0.013
Minor/None	0.7	38.9	0.016
Total	1.8	100.0	0.040
All Accidents (1964 - 1982)	4,510		100.0
Number of People Injured in Accidents Involving Buildings and Residences (1964-1982)[b]			
Type of Injury			
Fatal	1.8	28.7	
Serious	1.3	20.5	
Minor/None	3.3	50.8	
Total	6.4	100.0	

Sources:
NTSB, Annual Review of Aircraft Accident Data — U.S. General Aviation, 1982-1989
Aircraft Owners and Pilots Association (1985)

Table 8E

Accidents Involving Objects or People on the Ground

single-engine airplane flying at minimum speed is equivalent to that of a small automobile travelling at about 55 miles per hour. By comparison, a cabin-class twin would generate kinetic energy similar to that of a loaded 10-ton truck traveling 60 miles per hour (McElroy – 1973).

- **Aircraft Design Factors** – Unlike automobiles, aircraft are not designed for collisions. The disintegration of the wings and fuselage of a small, general aviation aircraft as it collides with a building dissipates much of the kinetic energy that would otherwise be delivered to the structure.

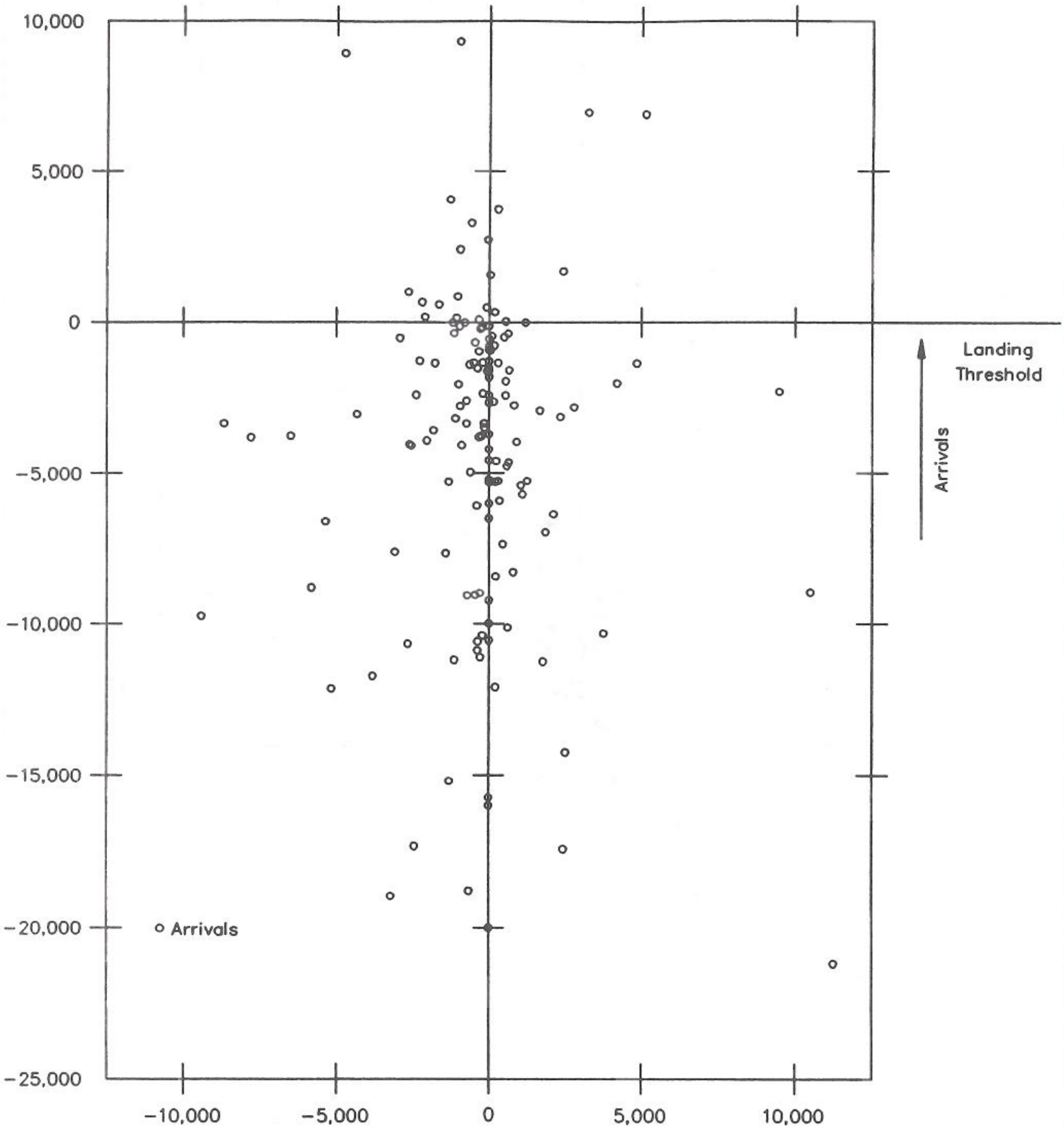
- **Frequency of Occurrence** – As stated above, general aviation aircraft collisions with buildings of any kind, and residences in particular, happen infrequently.

- **Range of Consequences** – *When* an aircraft collides with a small building, the results can range from insignificant to catastrophic. Neither data nor analyses can predict the actual effects of a particular incident.

Non-Occupant Injuries

Injuries to people on the ground (i.e., people who are not occupants of the aircraft) as a result of general aviation aircraft accidents occur even less frequently than collisions with buildings. Most such incidents take place on-airport. National data on injuries to people in residences and other buildings over a 19-year period is summarized in the previously referenced Table 8E. Over the period examined, only 3.1 accidents per year resulted in fatal or serious injuries to people in a building.

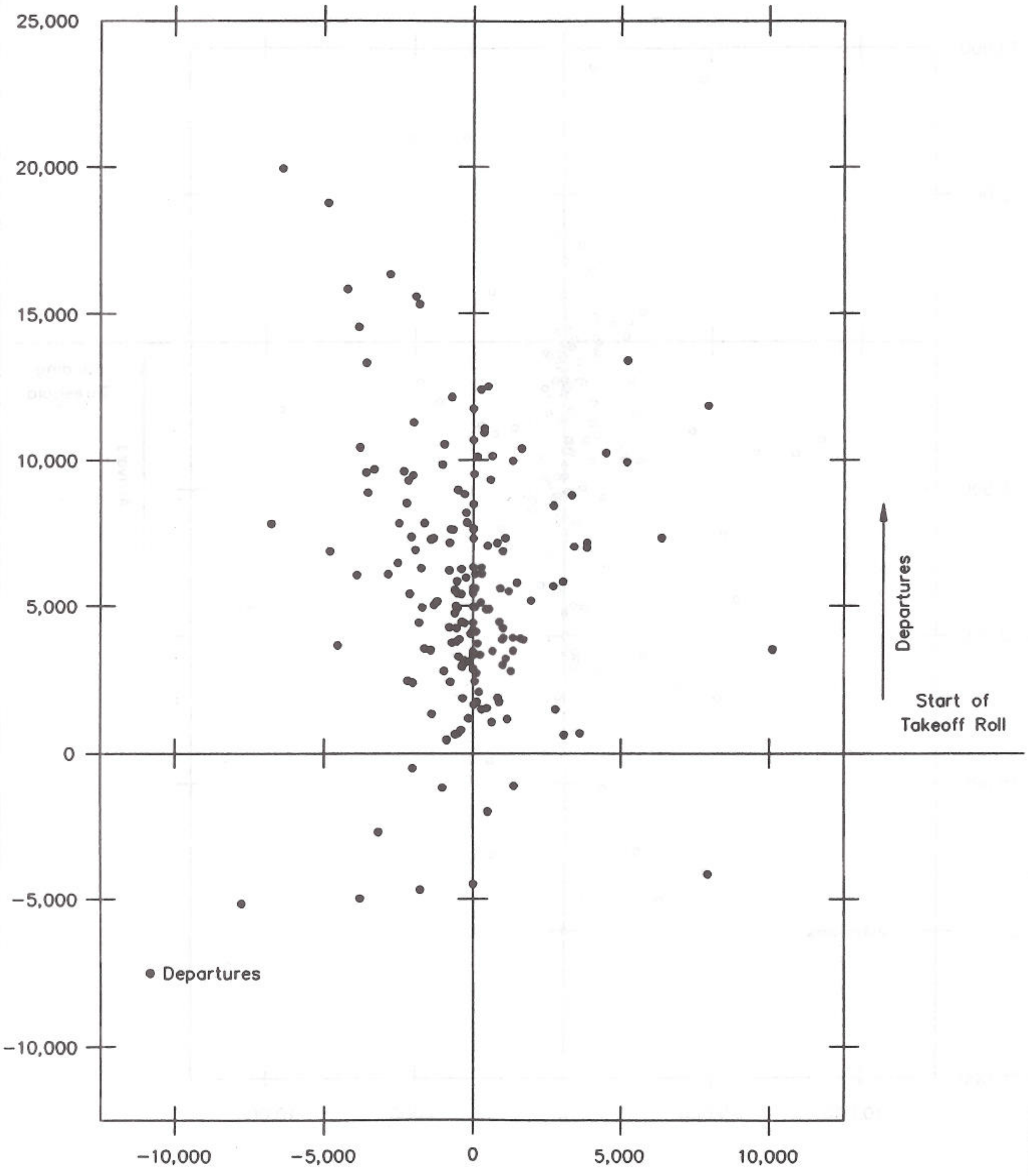
A direct comparison with accidents in the *Handbook* database cannot be made because the database includes only off-airport accidents and does not distinguish between people in buildings and elsewhere on the ground. Nevertheless, the results show a similarly infrequent occurrence of people on the ground being seriously or fatally injured by an aircraft accident. Only 9 such accidents are in the database.



Source: Hodges & Shutt (December 1993)

Exhibit 8A

Arrival Accident Location Pattern

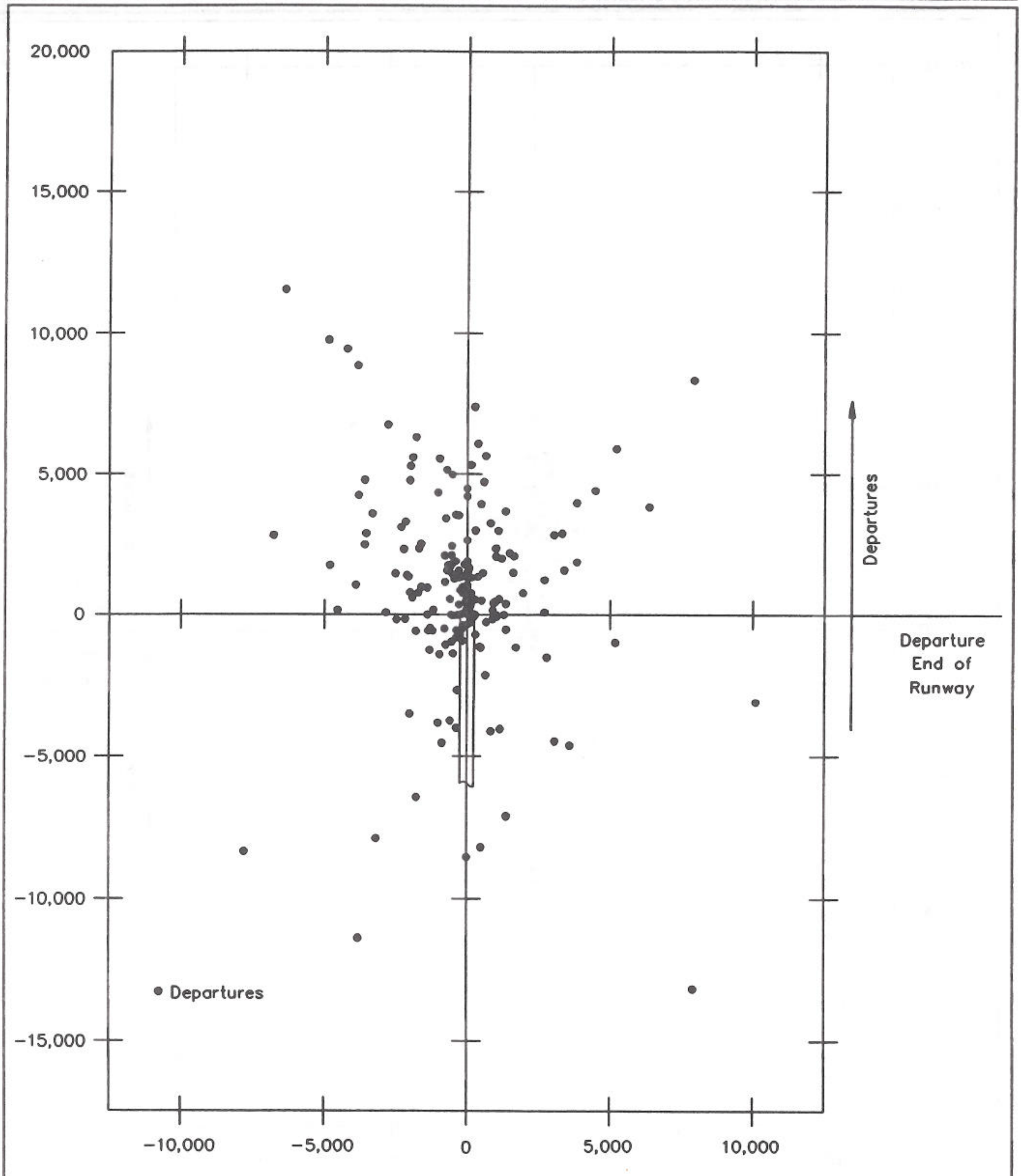


Source: Hodges & Shutt (December 1993)

Exhibit 8B

Departure Accident Location Pattern

Measured from Start of Takeoff Roll

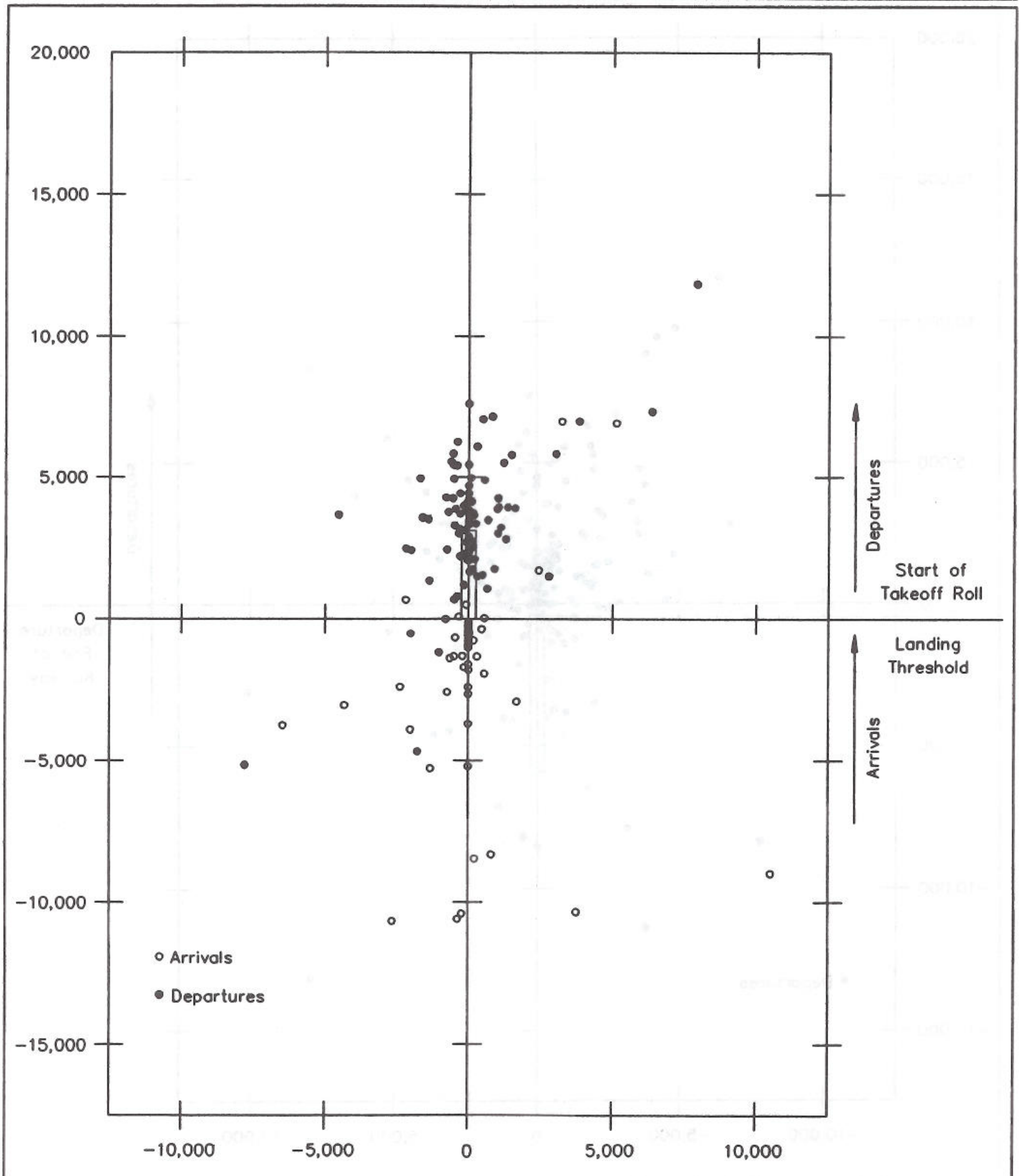


Source: Hodges & Shutt (December 1993)

Exhibit 8C

Departure Accident Location

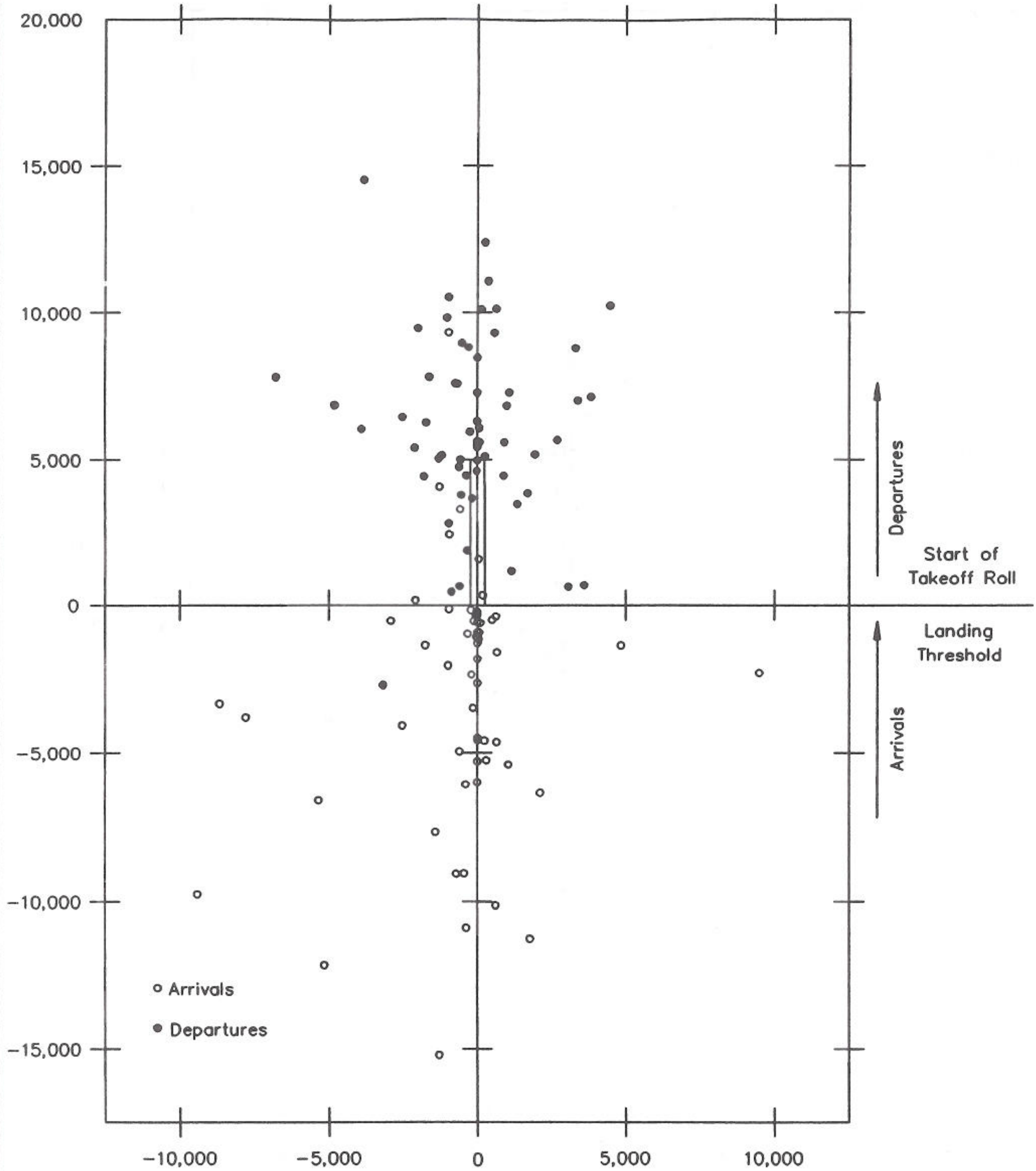
Normalized for Runway Length



Source: Hodges & Shutt (December 1993)

Exhibit 8D

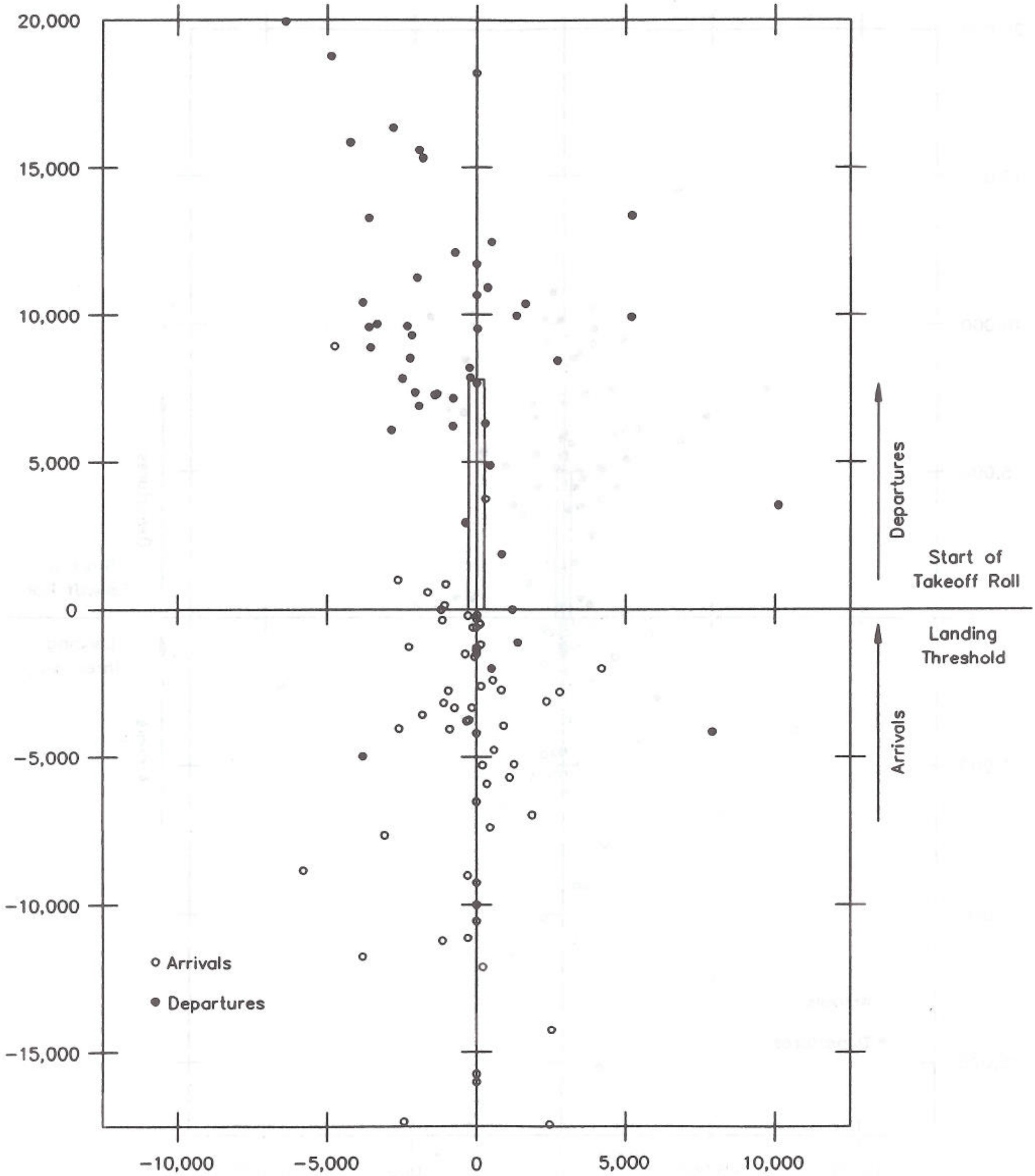
Accident Sites for Runways of Less than 4,000 Feet



Source: Hodges & Shutt (December 1993)

Exhibit 8E

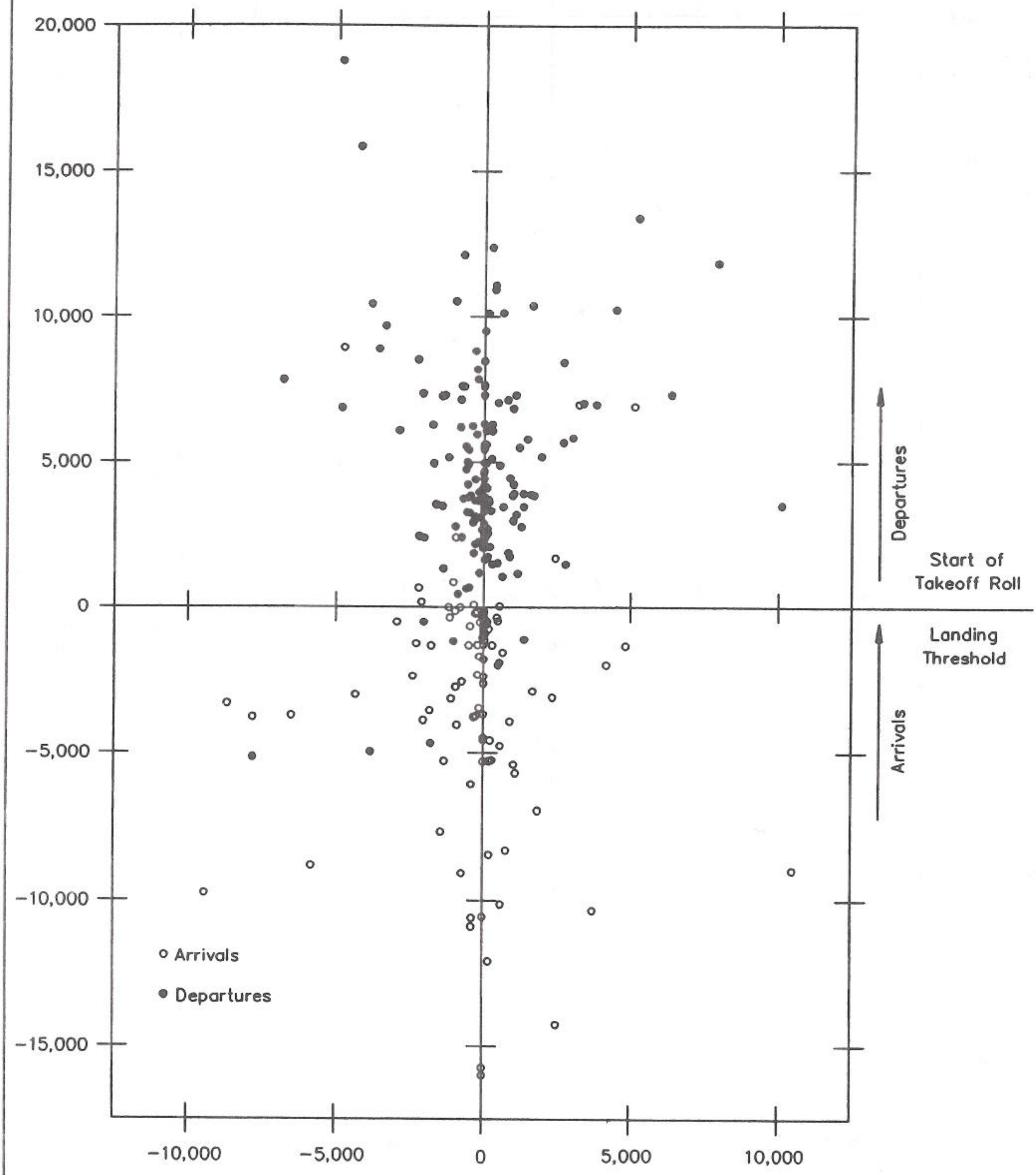
Accident Sites for Runways of 4,000 to 5,999 Feet



Source: Hodges & Shutt (December 1993)

Exhibit 8F

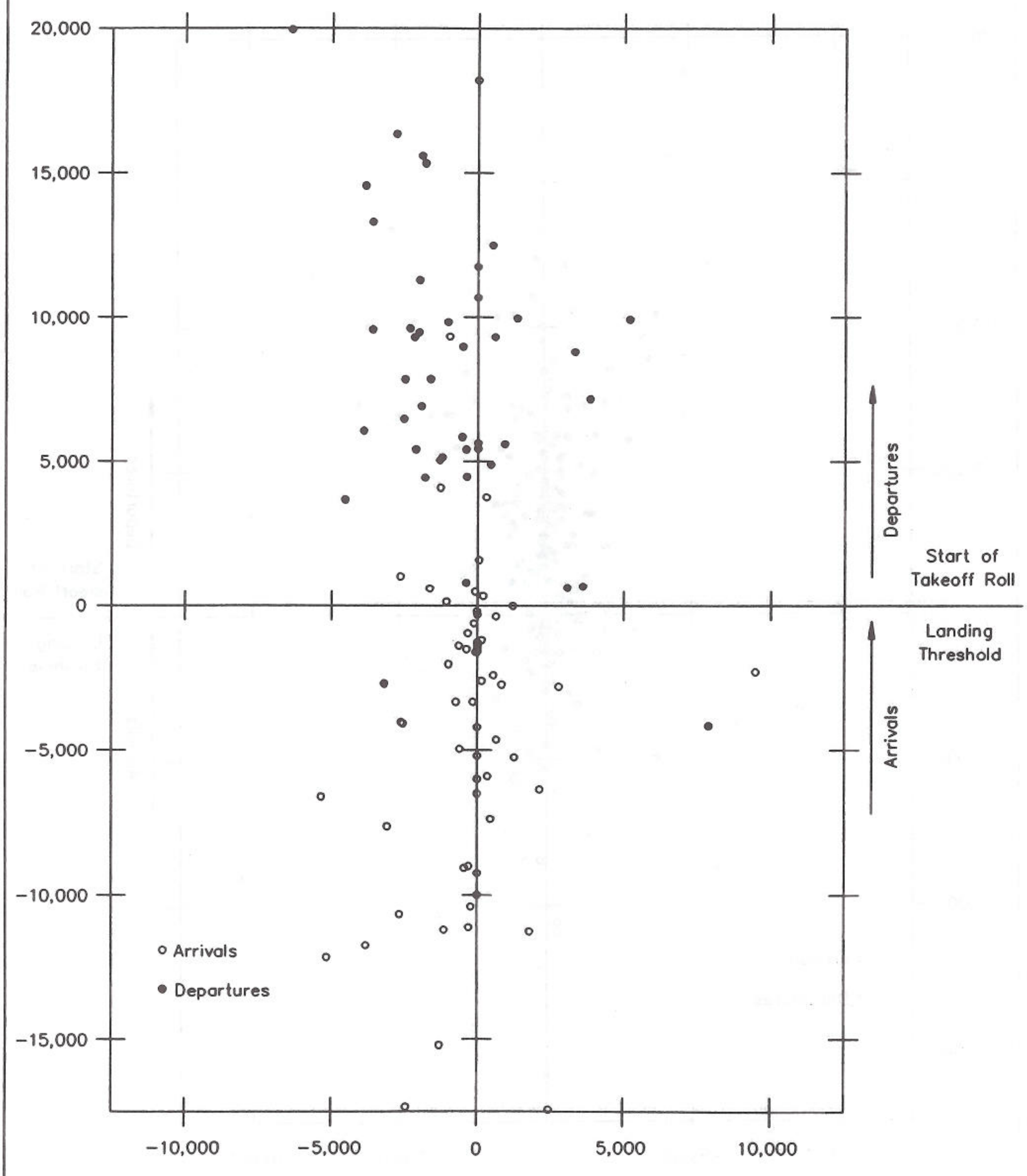
Accident Sites for Runways of 6,000 Feet or More



Source: Hodges & Shutt (December 1993)

Exhibit 8G

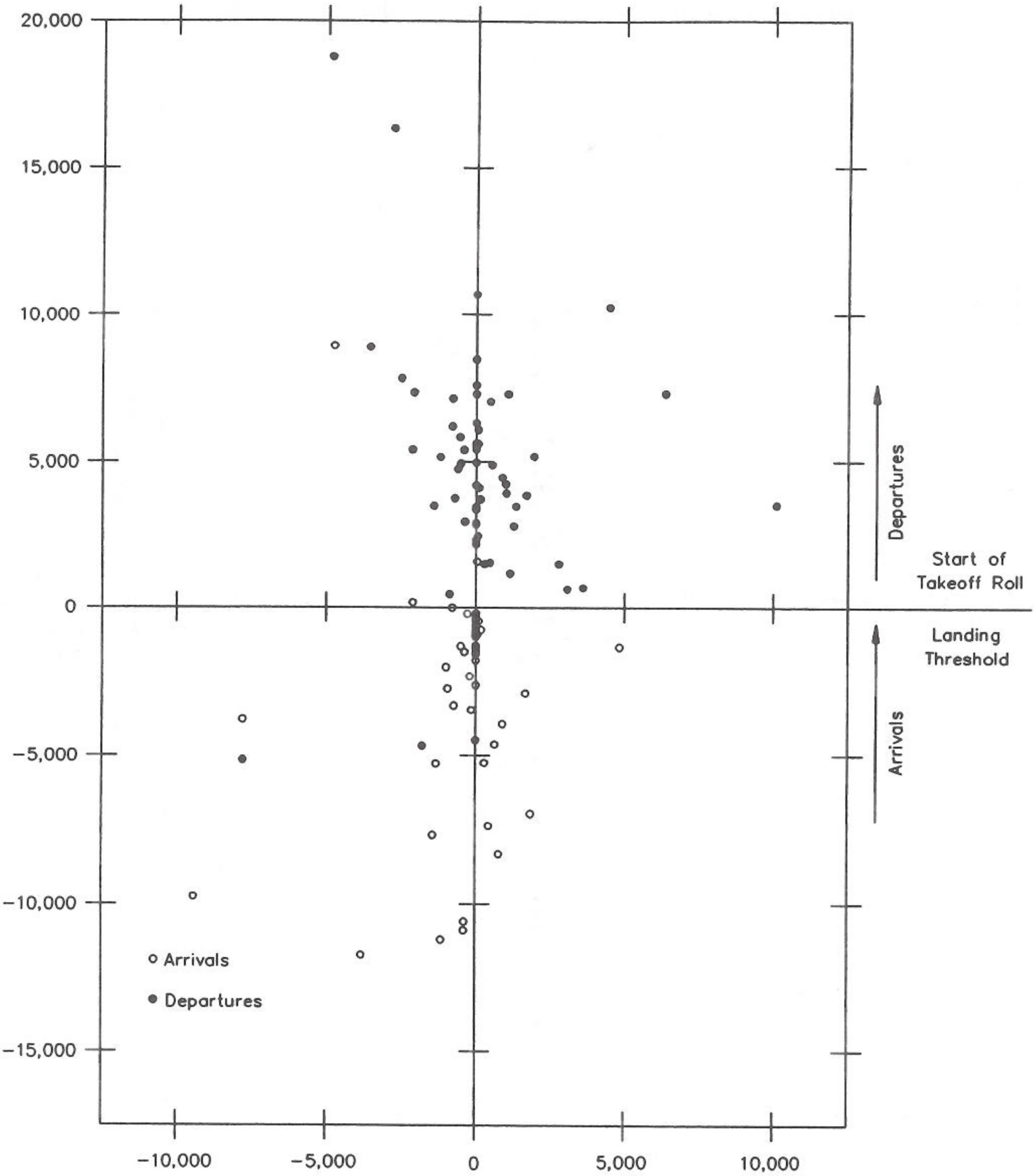
Single-Engine Airplane Accident Pattern



Source: Hodges & Shutt (December 1993)

Exhibit 8H

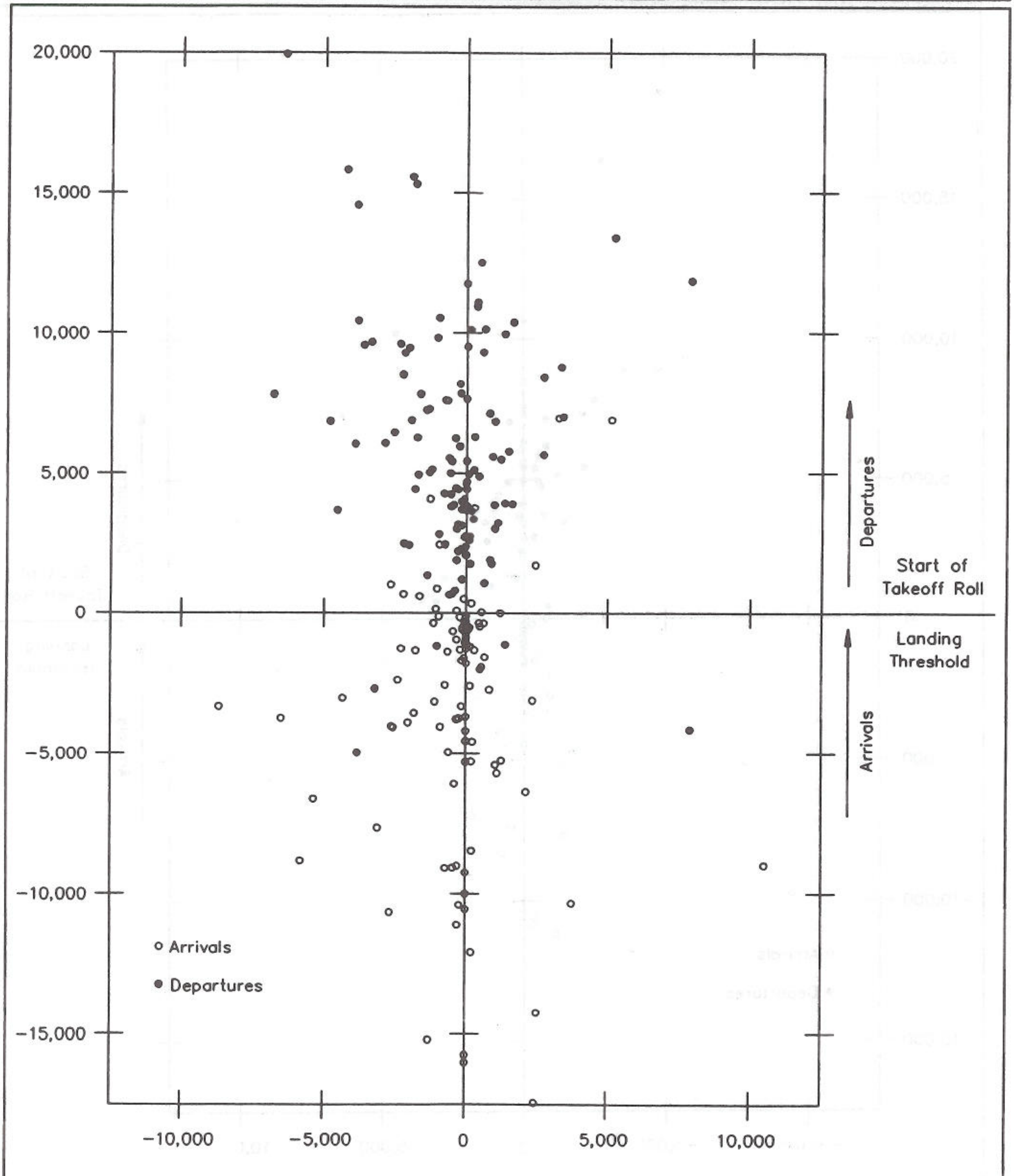
Multi-Engine Airplane Accident Location Pattern



Source: Hodges & Shutt (December 1993)

Exhibit 8I

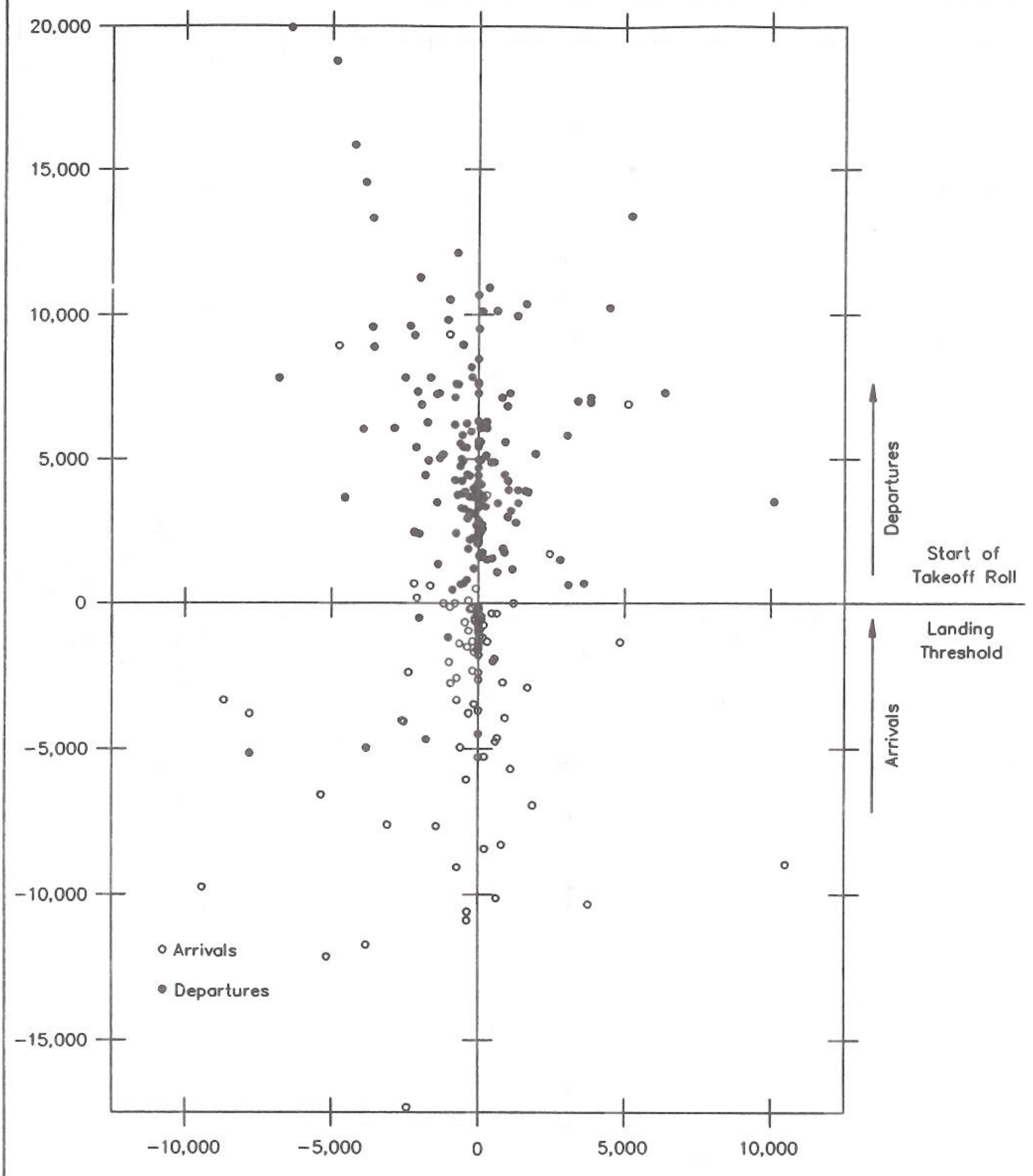
Locations of Accidents with Some Pilot Control



Source: Hodges & Shutt (December 1993)

Exhibit 8J

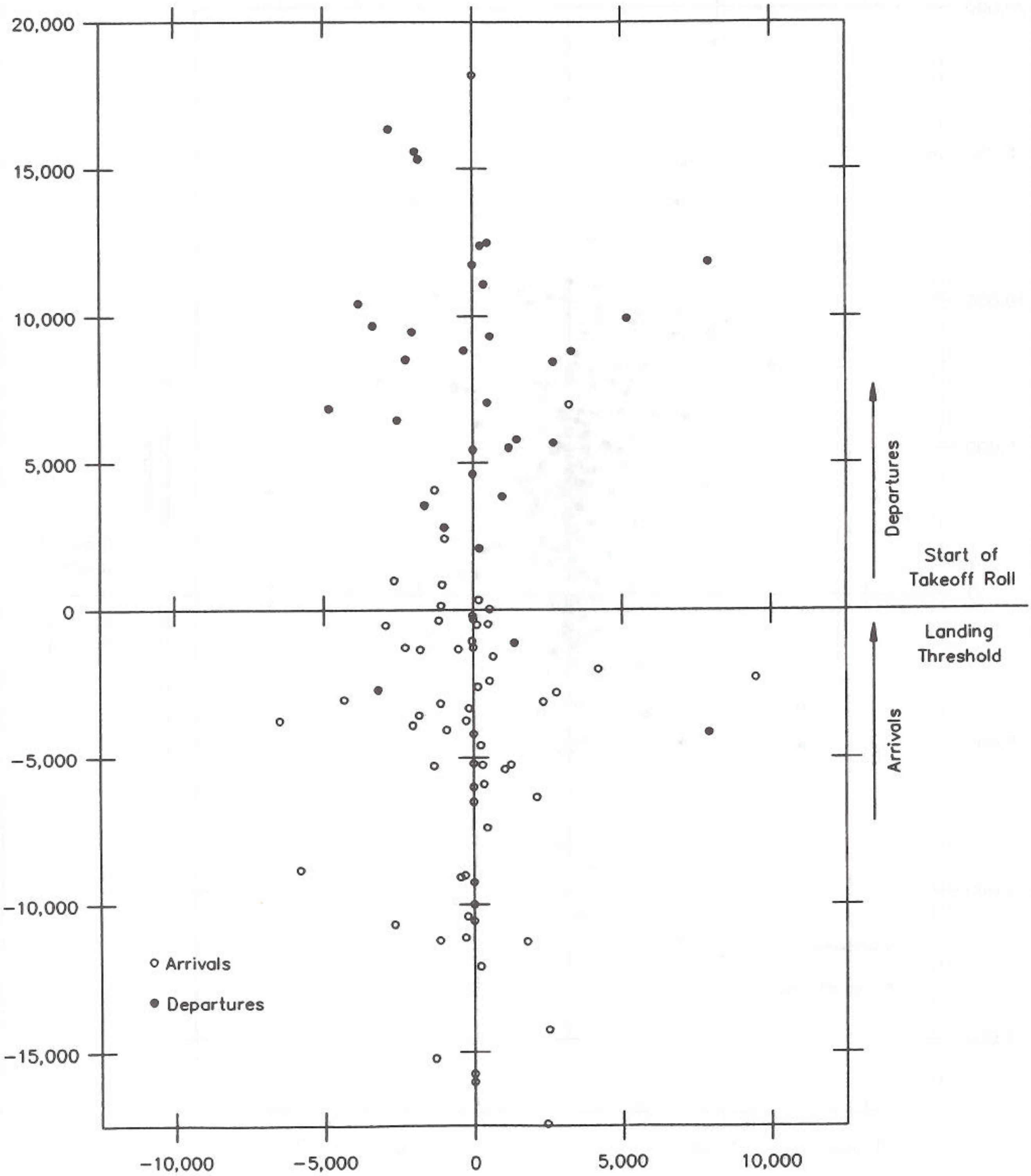
Locations of Accident with No Pilot Control



Source: Hodges & Shutt (December 1993)

Exhibit 8K

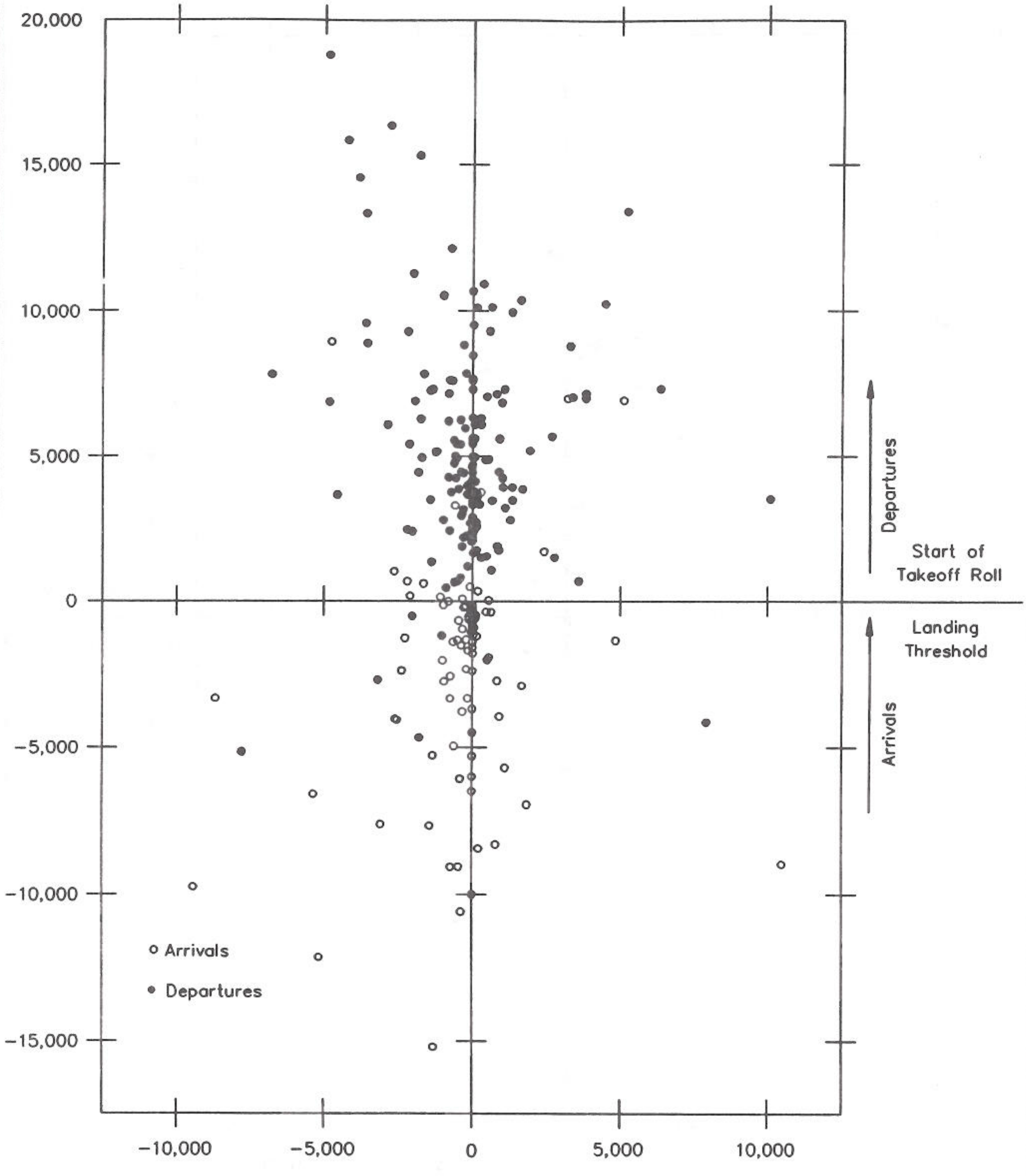
VFR Accident Locations



Source: Hodges & Shutt (December 1993)

Exhibit 8L

IFR Accident Locations

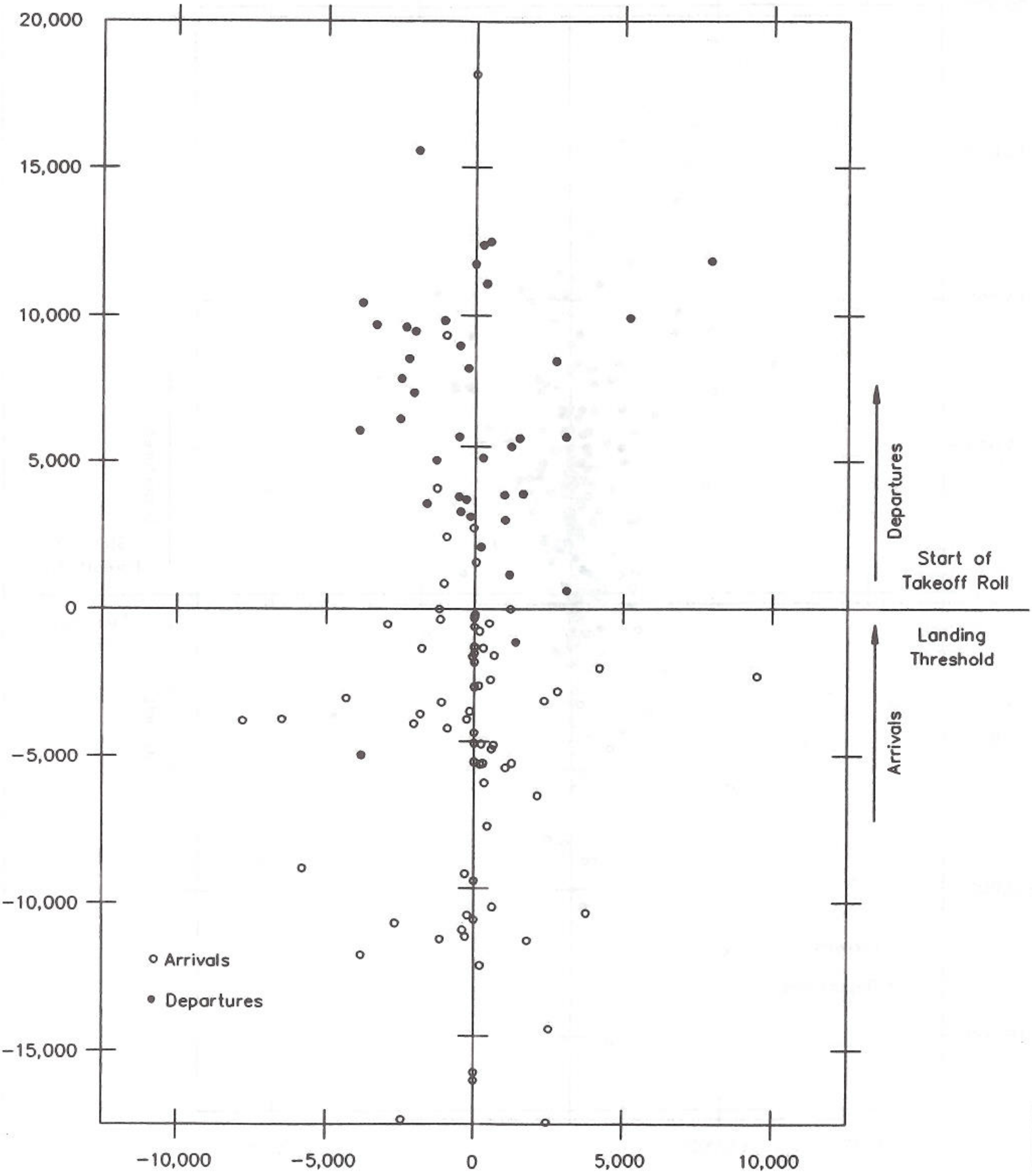


Source: Hodges & Shutt (December 1993)

Exhibit 8M

Daytime Accident Location Pattern

Measured from Start of Takeoff Roll



Source: Hodges & Shutt (December 1993)

Exhibit 8N

Nighttime Accident Location Pattern

Chapter 9

Safety Compatibility Policy Issues

9

Safety Compatibility Policy Issues

This chapter expands upon the safety and airspace protection concepts outlined in Chapter 3. It analyzes the accident data presented in Chapter 8 and assesses how this data and other factors can be applied to the development of safety compatibility policies which can be included in the compatibility plans prepared by airport land use commissions.

ESTABLISHED SAFETY COMPATIBILITY GUIDELINES

Airport land use commissions' task of developing safety compatibility policies for land uses in the vicinity of airports has been made difficult not only by the scarcity of accurate accident location data, but also by the limited existence of previously established criteria from other sources. The paragraphs below summarize some of the land use safety compatibility criteria which have been developed by federal and state agencies.

Federal

Federal Aviation Administration

Land use safety compatibility guidance from the Federal Aviation Administration is limited to the immediate vicinity of the runway, the runway protection zones at each end of the runway, and the protection of airport airspace. The lack of FAA land use compatibility criteria for other portions of the airport environment is often cited by land use development proponents as an indication that further controls on land use are unnecessary. What must be remembered, however, is that the FAA regards its criteria as minimum standards. State and local agencies are free to set their own land use compatibility policies as they see fit.

These standards are set forth in an FAA Advisory Circular entitled *Airport Design* (AC 150/5300-13).

- **Runway Vicinity** — The emphasis in FAA safety criteria is upon the runway surface itself and the immediately adjoining areas. Standards are established which specify ground surface gradients for areas adjacent to runways and the acceptable location and height of aeronautical equipment placed nearby. These areas normally are encompassed within airport boundaries.

Runway protection zones (previously called *clear zones*) date from a recommendation in the 1952 *Report of the President's Airport Commission*. See Chapter 8 for additional information.

- **Runway Protection Zones (RPZs)** — Runway protection zones are trapezoidal-shaped areas located at ground level beyond each end of a runway. The dimensions of RPZs vary depending upon:
  - The type of landing approach available at the airport (visual, non-precision, or precision); and
  - The characteristics of the critical aircraft operating at the airport (weight, wingspan, and approach speed).

  Ideally, each runway protection zone should be entirely clear of all objects. The FAA strongly recommends that airports own this property outright or, when this is impractical, to obtain easements sufficient to control the land use. Acquisition of this property is eligible for FAA grants.

  Beyond the runway protection zones, the FAA has no specific land use criteria other than airspace protection. However, additional property can also potentially be acquired with federal grants if necessary to restrict the use of the land to activities and purposes compatible with normal airport operations. In general, this property must be situated in the approach zones within a distance of 5,000 feet from the runway primary surface.

Excerpts from FAR Part 77 are contained in Appendix E.

- **Airspace Protection** — Part 77 of the Federal Aviation Regulations (FAR), *Objects Affecting Navigable Airspace*, has been adopted as a means of monitoring and protecting the airspace required for safe operation of aircraft at an airport. These regulations require that the FAA be notified of certain proposed construction or alteration of objects, whether permanent or temporary or of natural growth, within a specified vicinity of an airport. Standards for determining what constitutes an obstruction to air navigation also are established. These standards are defined in terms of imaginary surfaces in the airspace extending about two to three miles from the runway ends (and nearly eight miles in the case of a precision instrument approach corridor).

  Part 77 gives the FAA no authority to enforce the standards. Also, nothing in the regulations prohibit a state or local government from taking actions which are contrary to the federal standards. A principal consequence of such an action is that the owner of an airport could be found in noncompliance with the conditions agreed to upon receipt of airport development grant funds and could become ineligible for future grants (or, in extreme cases, be required to repay part of a previous grant). Another consequence is that airfield changes may be required as a result of airspace obstructions. For example, displacement of a landing threshold may be necessary. Also, for airports with instrument approaches, an obstruction could necessitate modification to the approach procedure (particularly greater visibility and/or cloud ceiling minimums) or even require elimination of the approach.

Additional guidelines regarding protection of airport airspace are set forth in other FAA documents. In general these criteria specify that no use of land or water anywhere within the boundaries encompassed by FAR Part 77 should endanger or interfere with the landing, take off, or maneuvering of an aircraft at an airport (FAA – 1987). Specific characteristics to be avoided include:

- Creation of electrical interference with navigational signals or radio communication between the airport and aircraft;
- Lighting which is difficult to distinguish from airport lighting;
- Glare in the eyes of pilots using the airport;
- Smoke or other impairments to visibility in the airport vicinity; and
- Uses which attract birds and create bird strike hazards.

With regard to bird strike hazards, the FAA specifically considers waste disposal sites (sanitary landfills) to be incompatible land uses if located within 10,000 feet of a runway used by turbine-powered aircraft or 5,000 feet of other runways. Any waste disposal site located within 5 miles of an airport is also deemed incompatible if it results in a hazardous movement of birds across a runway or aircraft approach and departure paths (FAA, Office of Airport Safety and Standards – 1990).

U.S. Department of Defense

Safety compatibility criteria for military air bases are set forth through the Air Installation Compatible Use Zone (AICUZ) Program. The objective of this program is to encourage compatible uses of public and private lands in the vicinity of military airfields through the local communities' comprehensive planning process.

As noted in Chapter 8, these dimensions were developed based upon a study of where military aircraft accidents have occurred in the past.

AICUZ standards establish three Accident Potential Zones (APZs) beyond each end of a military airbase runway. The innermost zone — the clear zone — is either trapezoidal in shape (at Navy bases) or rectangular (at Air Force bases). Two additional zones — designated APZ I and APZ II — lie beyond the clear zone. The alignment of these zones may be altered to follow the primary flight tracks. The clear zone length is typically 3,000 feet. Other dimensions vary depending upon the type of aircraft and/or number of aircraft operations on the runway. For runways used only by light aircraft, APZ I and APZ II typically are each 2,500 feet long and 1,000 feet wide. APZs for runways used by larger aircraft are commonly 3,000 feet wide and may have lengths of as much as 5,000 feet for APZ I and 7,000 feet for APZ II.

Exhibits 8A and 8B in Appendix C show examples of AICUZ safety compatibility criteria and an associated map.

Within each zone, the compatibility or incompatibility of possible land uses is specified. For example, residential uses are considered incompatible in the clear zone and APZ I and compatible only at low densities in APZ II. Retail land uses are unacceptable in the clear zone and may or may not be compatible in APZ I and II depending upon on the density of use.

State of California

State Regulations

California state laws and regulations pertaining to off-airport safety compatibility are found in two primary locations:

- **State Aeronautics Act** – As is true at the federal level, California state regulations provide little guidance with respect to airport land use safety compatibility. Perhaps the most significant provision is to give the State Division of Aeronautics enforcement powers regarding FAR Part 77. Chapter 4, Article 2.7 of the Aeronautics Act prohibits any person from constructing any structure or permitting any natural growth of a height which would constitute a hazard to air navigation as defined in FAR Part 77 unless a state permit or federal exemption is obtained. This regulation applies to objects located within one mile of an airport boundary.

- **State Education Code** – This state law (Education Code, Section 39005) requires that any school district proposing to acquire a site for an elementary or secondary school located within two miles of an airport runway notify the Department of Transportation of this intended action. The Division of Aeronautics is then required to investigate the site and report back to the school district. Another section of the Education Code (81036) establishes similar requirements for community college sites.

California Division of Aeronautics

As with the current *Handbook* volume, the 1983 document does not establish regulations, policies, or standards. Both documents merely make recommendations and suggestions for consideration by individual airport land use commissions, counties, and cities.

The previous (1983) version of the *Airport Land Use Planning Handbook* issued by the California Department of Transportation, Division of Aeronautics contained a section listing "suggested guidelines for safety zones." These guidelines are essentially a composite of the criteria found at that time in compatibility plans adopted by airport land use commissions throughout the state. Establishment of up to five separate zones was proposed:

- **Inner Safety Zone** – This zone was defined as normally coinciding with the runway protection zone (clear zone) or a rectangular area encompassing it. The guidelines recommended that the shape of the zone be modified to reflect close-in arrival and departure path turns. No structures and few, if any, people (a maximum of 10 per acre at any one time) were to be permitted.

Outer Safety Zone Lengths

Runways used by:

- Single-engine general aviation aircraft 2,000 feet
- Twin-engine general aviation aircraft 3,500 feet
- Business and commercial jets and all precision instrument runways 5,000 feet

- **Outer Safety Zone** — An extension of the inner safety zone, this zone was suggested to consist of either the FAR Part 77 approach zone or an equivalent rectangular area, modified as necessary to follow major flight tracks. The previous *Handbook* proposed that the outer end of the zone be located at a specified distance from the runway primary surface, depending upon the type of aircraft utilizing the runway (see box at left). The development criteria which were recommended included:
  - For uses in structures, no more than 25 people per acre at any time and no more than 150 people in any one building.
  - For uses not in structures, no more than 50 people per acre at any time.
  - Open areas — large enough and properly shaped and oriented to accommodate a forced, but controlled, aircraft landing — comprising 50% of the total zone. The guidelines suggested that streets and parking areas be considered open areas for the purposes of this computation.

- **Emergency Touchdown Zone** — This zone was defined as consisting of a 500-foot-wide strip running the length of both the inner and outer safety zone. The 1983 *Handbook* advised that it be free of all obstructions so as to allow for the emergency landing of aircraft.

- **Traffic Pattern/Overflight Zone** — Encompassing the common flight tracks to and from an airport, the limits of this zone could generally be defined by the FAR Part 77 horizontal surface. It was recommended that large assemblages of people be excluded and the lot coverage for commercial uses not exceed 40% to 50%.

- **Extended Runway Centerline** — This zone, applicable only to precision and nonprecision instrument runways, was suggested to be comprised of a 1,000-foot-wide corridor extending 10,000 feet from the runway threshold. Uses involving large concentrations of people were discouraged in this area.

Other Agencies

Oregon Aeronautics Division

A set of airport compatibility guidelines, similar in concept to those set forth in the 1983 California Division of Aeronautics *Handbook*, has been developed by the Oregon Aeronautics Division for use in that state (Oregon Department of Transportation – 1981). Two safety-related zones are proposed:

- **Clear Zone** – This area should be minimally used by people and be free of any construction or obstacle. Its dimensions are as provided in federal standards.
- **Approach Safety Zone** – The edges of this zone follow those of the FAR Part 77 approach surface. A length of 2,500 to 5,000 feet, depending upon the airport type and local desires, is suggested. At extremely busy airports with precision instrument approaches, a length greater than 5,000 feet may be appropriate. Uses in this zone should not attract large groups of people. Residential uses should be discouraged. Hospitals, rest homes, and other such uses are excluded. Offices, service businesses, and some retail activities are conditionally acceptable.

SAFETY ZONE ALTERNATIVES

The following discussion deals with the development of safety zones and associated criteria aimed at reducing the severity of aircraft accidents. Criteria intended to limit the frequency of accidents by protecting airport airspace are well defined by the FAA. The latter criteria are described in the final section of this chapter.

Evident from the preceding review of safety compatibility guidelines is that no single means of defining the area of safety compatibility concerns around airports is *correct* any more than a single way of measuring airport noise exposure is *correct*. Even with the support of the new accident site location data assembled for this *Handbook*, many variables must be considered when evaluating alternative safety zone shapes and sizes, whether in general or for a specific airport.

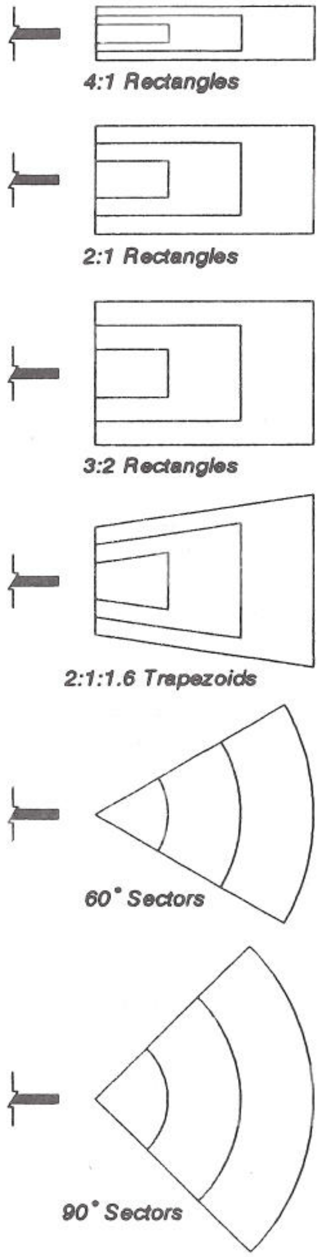
Generalized Safety Zones

The fact that accidents have historically occurred in certain locations is no guarantee that they will happen in precisely those places in the future, especially at any one airport. Nevertheless, it is reasonable to predict that the broad areas within which significant numbers of accidents have taken place in the past will be where most accidents also will occur in the future. Analysis of historical accident location data can help to define these broad areas or *safety compatibility zones*.

Because highly restricting the use of land everywhere within the vicinity of airports is normally impractical, the typical strategy is to have more restrictions in locations where accident risks are comparatively higher. This concept suggests two basic objectives to be sought in the analysis of historical accident location data:

- An indication of what shape of safety zones encompass the greatest concentrations of accident sites in the smallest acreage; and
- Identification of any points in this continuum where the ratio of accidents per acre changes noticeably.

Evaluated Safety Zone Shapes



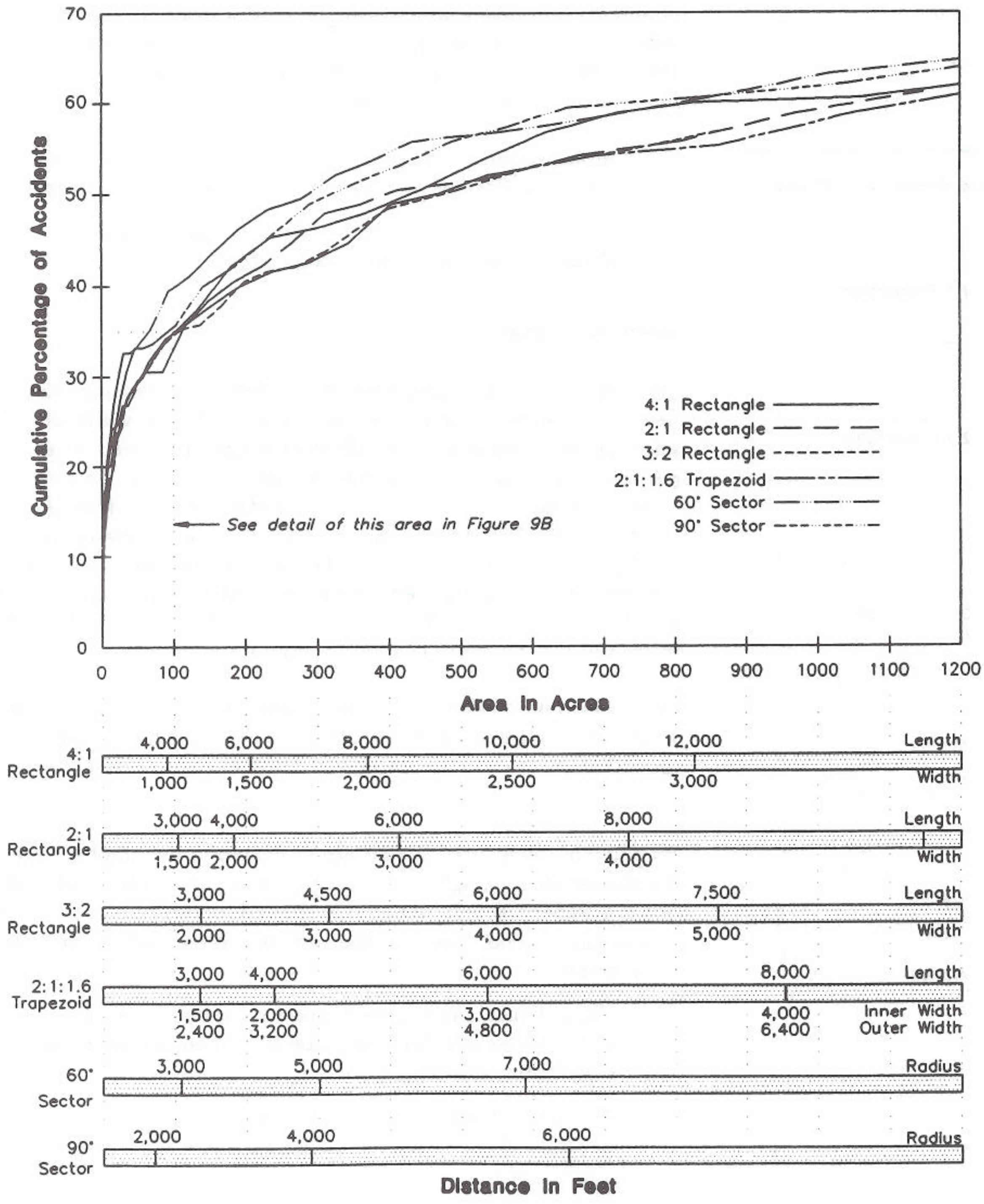
Safety Zone Shape

One approach to assessing alternative safety zone configurations is to determine the percentage of accident sites contained within alternative safety zones of *equal area*, but *different shape*. This percentage of points per acre is referred to here as the *capture rate*. Figures 9A through 9D present this analysis for the accident-site data obtained from the *Handbook* database. Data on arrival accidents is graphed in the first two figures; departure accident data in the second pair. The departure accident site data is graphed based upon distances *normalized* for the length of the runway -- that is, acreages and distances are plotted with respect to the departure (climb-out) end of the runway.

Within each pair of figures, the first examines a large area encompassing 1,200 acres and extending 2 to 3 miles from the runway ends. The second graph in each set focuses on the 100 acres closest to the runway ends.

Six different safety zone shapes are evaluated in the graphs. Three of the shapes are rectangles with varying aspect (length to width) ratios; one is a trapezoid; and two are fan-shaped sectors of a circle centered on the runway end. Several observations can be made from a review of these graphs:

- The optimum safety zone shape for capturing arrival accident sites is not necessarily the best shape for encompassing departure accident sites, and vice versa.
- The most efficient shapes for the area closest to a runway end generally do not have the greatest capture rates over a more extended area.
- For close-in arrival accident sites, the two fan-shaped sectors capture the most points per acre. These shapes also do well for close-in departure accidents sites, although other shapes are generally equivalent.

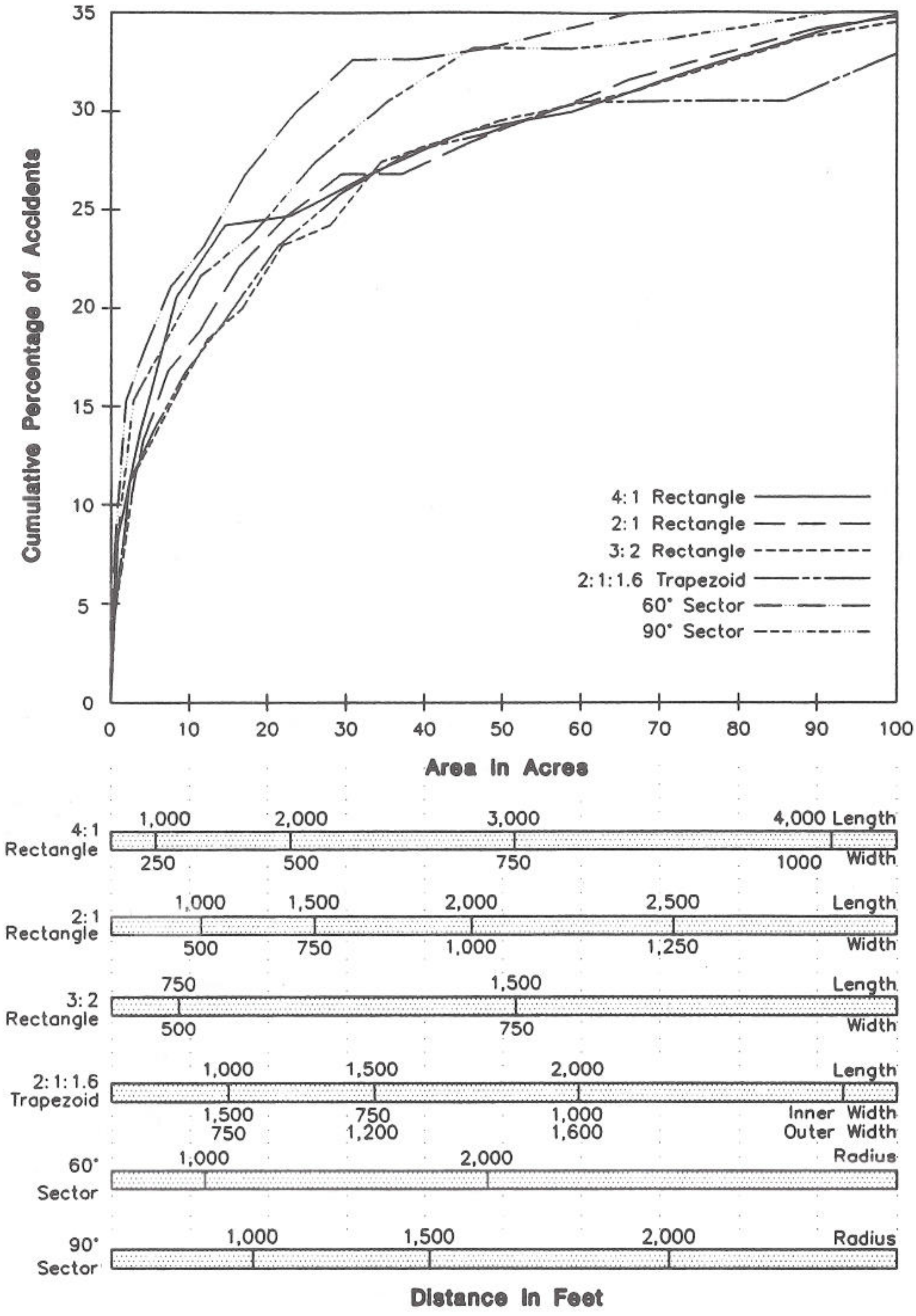


Source: Hodges & Shutt (December 1993)

Figure 9A

Comparison of Safety Zone Capture Rates

Arrival Accident Sites

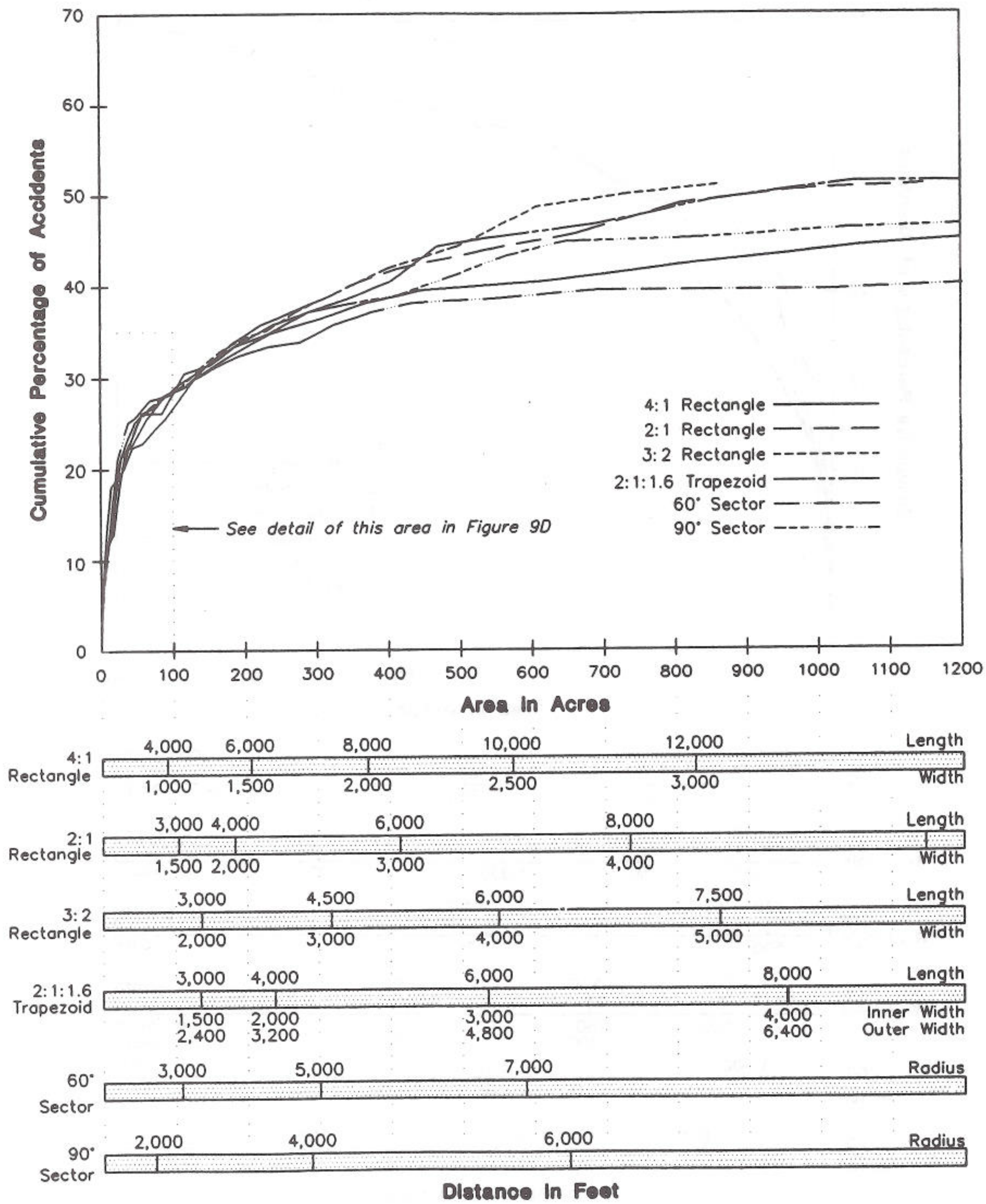


Source: Hodges & Shutt (December 1993)

Figure 9B

Comparison of Safety Zone Capture Rates

Close-In Arrival Accident Sites

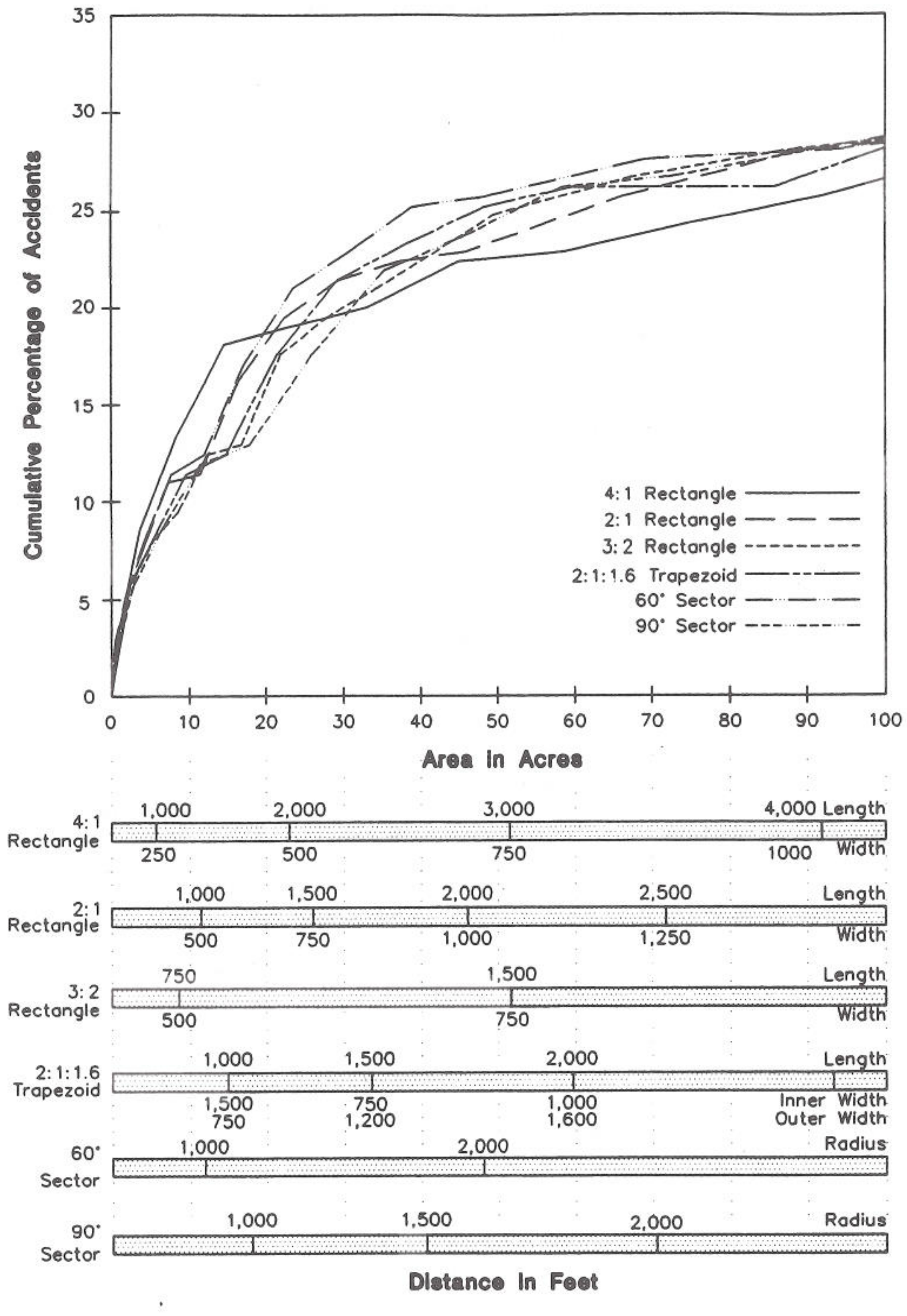


Source: Hodges & Shutt (December 1993)

Figure 9C

Comparison of Safety Zone Capture Rates

Departure Accident Sites



Source: Hodges & Shutt (December 1993)

Figure 9D

Comparison of Safety Zone Capture Rates

Close-In Departure Accident Sites

- Over larger acreages, the sector shapes and the narrow rectangle have slightly better capture rates for arrival accident sites, but the wide rectangles and the trapezoid shape do better for departures.

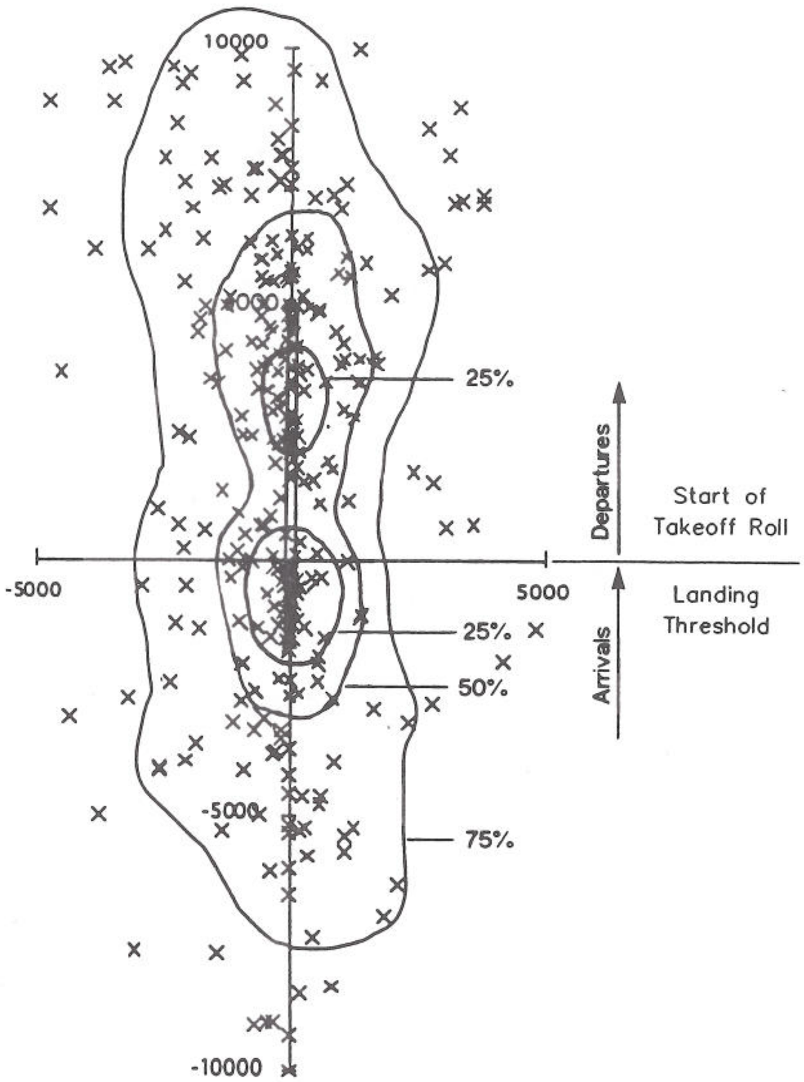
Distinct Change Points

Another piece of useful information is revealed by the changes in the slopes of the curves shown in Figures 9A through 9D. Where the curve is steep, relatively small increments of acreage significantly increase the percentage of accident sites encompassed. On the other hand, the flatter sections indicate that large amounts of acreage would have to be added to the size of a safety zone in order to gain a few more percentage points on the vertical scale. The most distinguishable breaks in the slope of the curve occur at three points:

- Within the first 20 to 25 acres, all of the curves are steep. This area (about 650-by-1,300 to 750-by-1,500 feet at an aspect ratio of 2:1) is roughly that of a runway protection zone for a visual or nonprecision instrument runway.
- At about 100 acres the curves begin to flatten.
- In the 100-to-300-acre range, the slopes of the curves begin to become shallower.
- Finally, at about 500 to 600 acres, the curves become quite flat. Even in this large acreage range, it should be noted that only some 60% of the arrival accident sites and 50% of the departure accidents sites occurring within 5 miles of the airport are encompassed. This is reflected in the Chapter 8 scatter diagrams which show numerous accident sites airport throughout the airport environs. Also, accident sites adjacent to the runway and in areas laterally from the runway end are not contained within any of the safety zone shapes evaluated here.

Another view of the change points in percentages of accidents encompassed by various areas is illustrated in Figure 9E. This diagram divides the total accident site data set (arrivals plus departures) into four equal groups of 25% each. The contours depict the smallest areas encircling 25%, 50%, and 75% of the accident sites with the remaining 25% occurring beyond the outer contour (including some points beyond the limits of the diagram).

- At the arrival (lower) end of the runway illustrated, the contours show that 50% of the accident sites are encompassed within a distance of approximately 3,000 feet from the runway end.
- The 50% contour at the departure (upper) end of the runway encompasses a larger area – a length of some 7,000 feet – because the data is plotted with respect to the start of takeoff roll, not the distance from the far end of the runway. This reflects the



Source: University of California, Berkeley, Institute of Transportation Studies (1993)

Figure 9E

Contour Plots of Accident Location Pattern

wide distribution of departure accidents when measured in this manner. As discussed above and in the preceding chapter, a tighter grouping of departure accident sites is apparent when the distances are measured from the far end of the runway.

One final perspective on the relative concentrations of accident sites is provided by Figure 9F. This drawing is a three-dimensional view of the same data depicted in Figure 9E. The vertical dimension to the graph represents the number of accident sites within each of the cells in the grid (the grid spacing used was 300 feet by 300 feet). The approach end of the runway is at the center of the graph and the runway extends up and to the right from there. Clearly evident is the concentration of accident sites – primarily arrivals – near the runway's approach end. The second hump lies along the runway and its extended centerline and is mostly comprised of departure accidents.

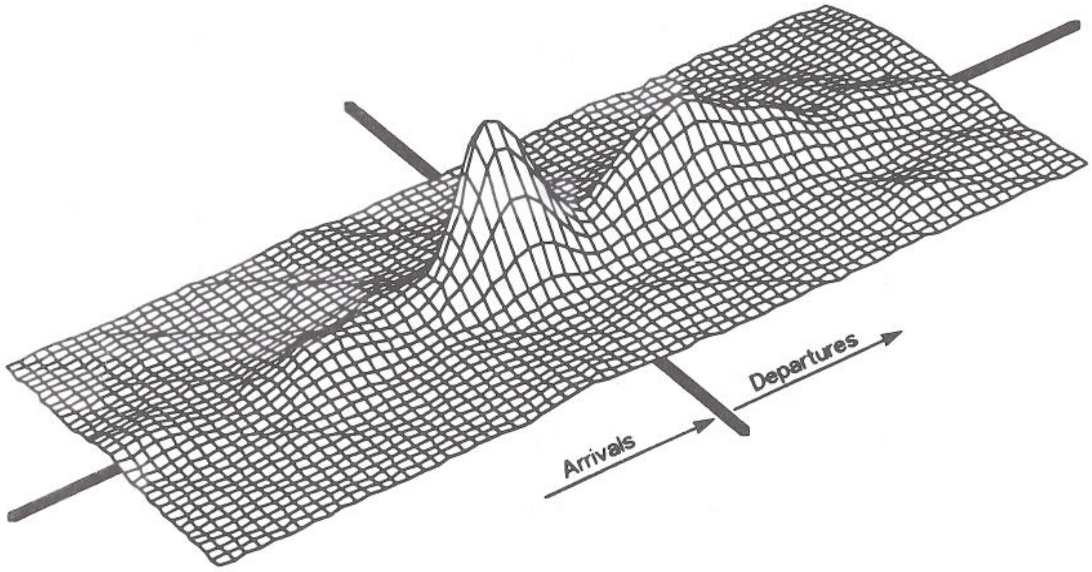
Application to Individual Airports

The above analysis is supportive of the concept, widely used by airport land use commissions, to establish several safety compatibility zones for areas beyond the runway ends with each increasingly larger zone having fewer land use restrictions. However, the information presented leaves open the question of how best to apply the new accident data to better delineation of the safety zones at individual airports. As a step toward this end, the following additional analysis of the accident data has been done.

It must be emphasized that the safety zone shapes and sizes described here are merely presented to illustrate the concepts discussed. Although they may serve as a useful starting point for individual compatibility plan development, these particular safety zones are not intended to represent Caltrans' recommendations, guidelines, or standards. Most compatibility plans do not now include all of the zones shown here, nor is it required for them to do so. Many ALUCs likely will find it appropriate to continue to use the safety zones they have already established.

First, a set of safety zones similar to ones used by some ALUCS was postulated. These are depicted in Figure 9G. Next, possible dimensions for each zone were assumed. The percentage of accident sites in each zone was then counted from the database and the capture rate was computed. Finally, except for the runway protection zone, the dimensions were adjusted in an effort to obtain a reasonable balance between the percentage of points falling within each zone and the zone's capture rate. (The runway protection zone size was fixed at standard FAA dimensions.) These calculations were done for three different subsets of the database: accidents associated with runways less than 4,000 feet long; those for runways 4,000 to 5,999 feet in length; and ones involving runways of 6,000 feet length or greater. The results are presented in Table 9A.

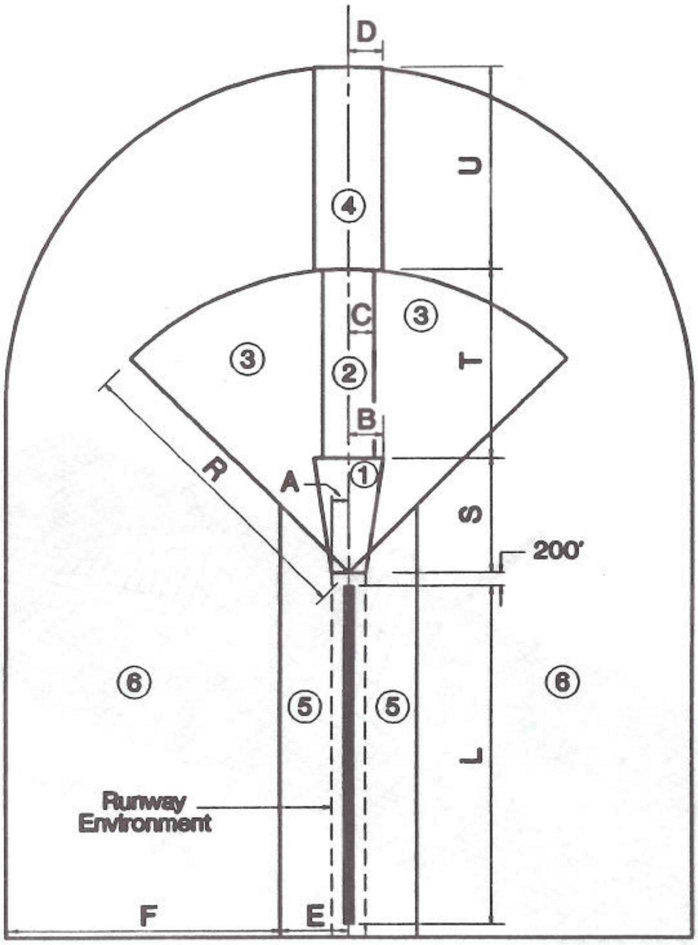
In reviewing this data, it is essential to reiterate that not just the points-per-acre capture rate, but also the percentage of points included must be considered. For any of the zones, the capture rate can be increased by reducing the dimensions. The percentage of points covered is generally reduced at the same time, however. At the extreme, a safety zone could be defined which contains just one historical accident site and the capture rate would approach infinity. A better use of the capture rate



Source: University of California, Berkeley, Institute of Transportation Studies (1993)

Figure 9F

Surface Plot of Accident Location Pattern



Safety Zone Names

1 Runway Protection Zone
2 Inner Safety Zone
3 Inner Turning Zone
4 Outer Safety Zone
5 Sideline Safety Zone
6 Traffic Pattern Zone

Note: These safety zone shapes and sizes are intended only to illustrate the concepts discussed in the text. They do not represent standards or recommendations.

Source: Hodges & Shutt (December 1993)

Safety Zone Dimensions (Feet)

Runway Length Group (L)	less than 4,000	4,000 to 5,999	6,000 or more
A	125	250	500
B	225	505	875
C	225	500	500
D	225	500	500
E	500	1,000	1,000
F	4,000	5,000	5,000
R	2,500	4,500	5,000
S	1,000	1,700	2,500
T	1,500	2,800	2,500
U	2,500	3,000	5,000

Figure 9G

Safety Zone Configuration Example

Safety Zone		Runway Length: Less than 4,000 Feet % of Points	Acres	%/Acre	Runway Length: 4,000 to 5,999 Feet % of Points	Acres	%/Acre	Runway Length: 6,000 Feet or More % of Points	Acres	%/Acre
Arrival Accident Sites										
Zone 1:	Runway Protection Zone	31%	8	3.88	23%	30	0.77	22%	79	0.28
Zone 2:	Inner Approach/Departure Zone	10%	16	0.63	8%	64	0.13	6%	57	0.10
Zone 3:	Inner Turning Zone	8%	113	0.07	5%	365	0.01	15%	451	0.03
Zone 4:	Outer Approach/Departure Zone	3%	26	0.13	7%	69	0.09	10%	115	0.09
Zone 5:	Sideline Zone	18%	72	0.25	19%	232	0.08	6%	234	0.03
Zone 6:	Traffic Pattern Zone	8%	700	0.01	10%	940	0.01	19%	1,247	0.02
Total:	Zones 1-6	79%	933	0.08	71%	1,700	0.04	79%	2,183	0.04
Departure Accident Sites										
Zone 1:	Runway Protection Zone	20%	8	2.46	17%	30	0.57	12%	79	0.16
Zone 2:	Inner Approach/Departure Zone	9%	16	0.61	3%	64	0.05	0%	57	0.00
Zone 3:	Inner Turning Zone	16%	113	0.14	9%	365	0.03	14%	451	0.03
Zone 4:	Outer Approach/Departure Zone	1%	26	0.04	5%	69	0.07	0%	115	0.00
Zone 5:	Sideline Zone	34%	72	0.48	23%	232	0.10	18%	234	0.08
Zone 6:	Traffic Pattern Zone	13%	700	0.02	35%	940	0.04	31%	1,247	0.02
Total:	Zones 1-6	93%	933	0.10	92%	1,700	0.05	76%	2,183	0.03
All Accident Sites										
Zone 1:	Runway Protection Zone	24%	8	3.01	20%	30	0.67	18%	79	0.23
Zone 2:	Inner Approach/Departure Zone	10%	16	0.62	6%	64	0.09	3%	57	0.06
Zone 3:	Inner Turning Zone	13%	113	0.11	7%	365	0.02	15%	451	0.03
Zone 4:	Outer Approach/Departure Zone	2%	26	0.07	6%	69	0.08	6%	115	0.05
Zone 5:	Sideline Zone	28%	72	0.40	21%	232	0.09	11%	234	0.05
Zone 6:	Traffic Pattern Zone	11%	700	0.16	23%	940	0.02	24%	1,247	0.02
Total:	Zones 1-6	87%	933	0.09	82%	1,700	0.05	78%	2,183	0.04

Notes:

- Totals may not equal the sum of the numbers above because of mathematical rounding.
- See Figure 9G for the shapes and dimensions of each zone.
- Accident site locations as indicated in *Handbook* database.

Source: Hodges & Shutt (December 1993)

Table 9A

Analysis of Postulated Safety Zones

data would be in establishing the relative levels of land use restrictiveness to be applied to each zone.

Further analysis of the accident location data may help to better define the appropriate safety zone shapes and sizes for any given airport. Other variables, such as those examined in Chapter 8, may also need to be taken into account. Lastly, as examined later in this chapter, the ALUC and the community will need to find its own acceptable balance between protection against accident risk and the implications of various degrees of land use restrictions.

THE CONCEPT OF ACCEPTABLE RISK

Definition of appropriate safety zones is one side of the safety compatibility equation. The other, even more difficult side is establishment of suitable land use criteria to be applied within each zone. As stated in Chapter 3, the basic objective of safety compatibility criteria is to minimize the risks associated with potential aircraft accidents. This objective has two components:

- To protect people and property on the ground when accidents occur; and
- To minimize injury to the occupants of aircraft involved in accidents.

For both of these components, the fundamental question to be answered when attempting to set land use development criteria is *how much risk is acceptable?* Answering this question is made particularly difficult by the fact that aircraft accidents occur infrequently and, for any specific location, probably will never happen. Yet, when an accident does take place, the consequences can be great.

The balancing side to the question of acceptable risk is *how much protection can be afforded?* When an airport is situated in a rural area, well away from development pressures, the cost — to the landowner, the community, and the airport — for a high degree of protection may be low. Important land use development can usually be redirected toward areas where the prospects of an aircraft accident are minimal. At the other end of the spectrum, the need for developable land around urban area airports typically is such that avoidance of only the most risky forms of development — those in the most accident-prone locations or ones which greatly increase the potential severity — may be affordable. The problem with accepting the latter concept, of course, is that an aircraft accident in a developed area hardly ever results in pressure to eliminate the conflicting land use; rather the pressure inevitably is to restrict or close the airport.

Some perspective on this tradeoff can perhaps be gained from a study which examined the implications of another type of hazard — the threat of volcanic eruption (William Spangle and Associates – 1987). A volcanic eruption can reasonably be considered an ultimate example of an event which occurs with very low frequency, but can have catastrophic results when it does occur. One of the responses considered in the report was whether anything at all should be done to protect against such an event given its extreme rarity. On the other hand, the report notes that "the potential for a major catastrophe which could be averted begs for some kind of public response" (page 86). As for where to strike the balance between acceptable risk and affordable protection, the report concludes: "Do what you can, politically and fiscally, to reduce the exposure and provide for effective emergency response and that becomes, by definition, acceptable risk. An official who proposes to go farther than his constituents want will find out quickly what the limits are" (page 86).

With respect to airport-related risks, the assessment presented in the 1952 *Report of the President's Airport Commission* referred to earlier in this chapter remains valid today. The report remarks that:

> "Absolute safety for the individual is an ideal which has ever been sought but never attained. Because man does not have full control over his environment, the very function of living has inherent hazards which become more pronounced as the scheme of living grows more complex. Thus, since absolute safety is a theoretical concept, one can speak only of relative risk" (pages 47-48).

The report goes on to say that:

> "... 'calculated risk' is an American concept which gives mobility to the whole social structure. The phrase simply means a willingness to embark deliberately on a course of action which offers prospective rewards outweighing its estimated dangers" (page 49).

PROTECTING PEOPLE AND PROPERTY ON THE GROUND

To protect people and property on the ground from the risks of near-airport aircraft accidents, some form of restrictions on land use are essential. Important factors to consider in developing safety compatibility criteria are examined below.

Land Use Characteristics

The potential severity of an off-airport aircraft accident is highly dependent upon the nature of the land use at the accident site. For the purposes of evaluating the relative risks presented by different land uses, three characteristics are most important:

As criteria for safety compatibility, maximum acceptable density of use numbers are commonly arrived at indirectly. First, certain types of land uses are qualitatively determined to be unacceptable for a given proximity to an airport. The typical number of people per acre attracted by these uses is then determined and subsequently set as the common basis for evaluating other types of land uses.

- **Density of Use** — The most direct means of limiting the potential severity of an off-airport accident is to limit the density of use. Density of use is typically measured in terms of the number of people which the development can attract per acre. This measure is the most useful common element by which to compare and evaluate the acceptability of most land uses.

  Some examples of the number of people per acre attracted by various land uses are listed below:

Typical Densities of Use (People Per Acre)

Light-industrial uses	35-50
Two-story motel	35-50
Shopping center (single story)	75-125
Single-story office structure (the upper limit would occur if the building housed 1 occupant per 100 square feet of floor area — the maximum occupancy load allowed under the Uniform Building Code — and covered 25% of the lot)	50-100
Sit-down restaurant	100
Fast food restaurant	150

- **Residential versus Nonresidential Function** — Residential land uses are normally judged differently than non-residential uses. For various reasons, most people probably would agree that residential uses should be afforded a comparatively higher degree of protection. Thus, while the density of residential development could be measured as a people per acre function, the standard dwelling units per acre measure is just as suitable for the purposes of evaluating safety compatibility.

- **Special Functions** — Certain other types of land uses are also commonly regarded as requiring special protection from hazards such as aircraft accidents. These uses fall into two categories:

  - Elementary and secondary schools, college campuses, hospitals, nursing homes, and other similar land uses for which the significant common element is the relative inability of the people occupying the space to move out of harm's way.

- Functions, such as aboveground storage of large quantities of flammable materials or other hazardous substances, which could substantially contribute to the severity of an aircraft accident if they were to be involved in one.

Acceptable Forms of Development

As is true with regard to the shape and size of safety zones, there is no *correct* answer to the question of acceptable risk. However, at least for the areas where the aircraft accident potential is greatest, a degree of consensus seems apparent that certain types of land uses are unwise.

Although perhaps not always attainable, the following guidelines are suggested as a good starting point especially in light of ALUCs' fundamental responsibility to promote a high degree of compatibility between airports and surrounding land uses. The individual zones described are as illustrated in Figure 9G.

- **Runway Protection Zones** — FAA and AICUZ criteria for land uses in RPZs are explicit: to the maximum extent practical, these areas should be clear of all structures; any activities must be very low intensity in character and confined to the sides and outer end of the area.
  - *Density of Use* — A density of 10 people per acre is the maximum normally judged acceptable.
  - *Residential Land Uses* — New residential development should be prohibited within RPZs.
  - *Special Functions* — These types of land uses also should be prohibited within RPZs.

The areas just beyond the RPZs are also typically exposed to significant levels of noise, especially at busy airports.

- **Inner Safety Zones** — Next to the RPZs, these approach/departure corridors have the highest level of exposure to potential aircraft accidents.
  - *Density of Use* — Nonresidential land uses should be limited to activities which attract relatively few people to a given area. Shopping centers, eating establishments, meeting halls, multi-story office buildings, and labor-intensive manufacturing plants, are examples of uses which should be prohibited. Measured on the density-of-use scale, the maximum concentrations of people generally should be no more than 40 to 60 per acre.
  - *Residential Land Uses* — Residential uses, if not deemed unacceptable because of noise, should be limited to very low densities —

10 acres or more per dwelling unit. In this proximity to an urban airport, low density effectively precludes residential development. In rural areas, the lot size requirements for *exclusive agriculture* or other similar zoning district should be considered the maximum acceptable density.

- *Special Functions* — Special function land uses (schools, storage of flammable materials, etc.) should be prohibited.

- **Inner Turning Zone** — The accident site patterns diagrammed in Chapter 8 show substantial numbers of points offset laterally from the extended runway centerline. This zone — included in some compatibility plans and often combined with the inner safety zone — reflects the historical distribution of accident sites. The inner turning zone as depicted in Figure 9G encompasses locations where aircraft are typically turning from the base to final approach legs of the standard traffic pattern and are descending from traffic pattern altitude. It also encompasses the area where departing aircraft normally complete the transition from takeoff power and flap settings to a climb mode and have begun to turn to their en route heading.

  - *Density of Use* — The criterion for the number of people per acre allowed for uses in this zone should either be the same as for the inner safety zone or can be adjusted slightly upward, but no higher than the levels set for the outer safety zone.

  - *Residential Land Uses* — The minimum lot size criteria for residential uses should be set somewhere in the range encompassed by the inner and outer safety zones; that is, between 2 and 10 acres.

  - *Special Functions* — Special function land uses should be prohibited.

- **Outer Safety Zones** — Many ALUCs have established outer or extended approach/departure safety zones, especially for runways which are long and/or have instrument approach capabilities. This concept is supported by both the 1983 *Handbook* and AICUZ compatibility criteria and is encouraged here.

  - *Density of Use* — The types of land uses which represent concerns within outer safety zones are similar to those in the inner safety zones, but somewhat higher densities of use can be considered acceptable. For example, whereas shopping centers and multi-story office buildings are unacceptable closer to the runway end, small, neighborhood shopping centers and two-story office are reasonable within this more distant zone. Concentrations of people should be limited to no more than 60 to 100 per acre.

  - *Residential Land Uses* — Typical subdivision-density residential development should continue to be avoided in this zone. Rural residential uses with lot sizes in the 2 to 5 acre range can be considered acceptable, however.

- *Special Functions* — Most special land use functions, particularly schools, hospitals, and so on, should be avoided in the outer safety zone.

- **Sideline Safety Zones** — At large airports, the areas of concern adjacent to runways and runway ends are normally contained within airport property. Aviation-related land uses on or adjoining airport property are typically viewed differently than non-aviation uses. Users of these facilities implicitly acknowledge some degree of risk simply by being present on the airport. All common aviation-related activities should be considered acceptable in this area provided that FAA airport design criteria are met.

  For airports where the sideline safety zone encompasses non-aviation property, either on or off the airport, the safety criteria for the inner turning zone or outer safety zone are generally applicable. However, land uses involving more than 40 to 60 people per acre should be avoided in locations lateral to the runway ends; if necessary, higher density uses should be situated laterally from near the mid-point of the runway.

- **Traffic Pattern Zone** — Within other portions of the airport area routinely overflown by aircraft, the potential for aircraft accidents is relatively low and the need for land use restrictions is thus minimal.

  - *Density of Use* — Only very large assemblies of people — in the 150 or more people per acre range — need to be avoided.
  - *Residential Land Uses* — In small communities, typical residential subdivision densities of 4 to 6 dwelling units per acre are acceptable from a safety perspective. In urban areas, even higher densities may be reasonable, especially if development is clustered to provide open space as discussed below.
  - *Special Functions* — Schools, hospitals and nursing homes should be avoided in traffic pattern zones unless no other feasible alternatives are available.

Measuring Density of Use

When developing density-of-use criteria, it is essential to define how the measurements are to be done. There are several sets of options which must be considered.

Gross versus Net Acreage

An area to be reviewed can be measured in terms of the entire site or zone, regardless of streets or parcel lines (its *gross acreage*) or the area of a given parcel (the *net acreage*). Because safety area land use restrictions are more effective when applied at a general plan or large development level than they are for small, individual parcels, measurement on a gross acre basis is more suitable. Gross acreage is also easier to calculate.

Average Densities of Use versus at Any Time

The people and dwelling units per acre guidelines indicated in the previous section are based upon gross acreage and maximum densities at any time. If different measures are used, the numbers may need to be adjusted accordingly.

Limitations on the numbers of people per acre sometimes are stated as a never-to-exceed maximum and sometimes as an average measured over an indicated period (typically 2, 8, or even 24 hours). A combination of the two also is possible (e.g., an average of x people per acre over an 8-hour period, not to exceed $2x$ at any time). It is recommended that restrictions be stated as a never-to-exceed maximum and the level set accordingly. This is the same approach as that taken by fire codes for buildings. An averaging approach assumes that an accident will not occur when a higher-than-average number of people is present.

Clustering Versus Spreading of Development

Given that the tradeoffs between safety and economic concerns usually dictate some amount of development near airports, particularly those in urban areas, a question to be considered is whether it is better for this development to be *clustered* or *spread out*.

- **Clustered Development** – The premise behind the concept of clustering is that, in most off-airport mishaps, the aircraft are under some degree of control when forced to land. Clustering thus allows a greater amount of open space toward which the pilot can aim. In addition to reducing the risks for people on the ground, open space also provides benefits for aircraft occupants, as addressed below. The disadvantage of clustering is that it allows an increased number of people to be in the potential impact area of an uncontrolled crash.

- **Spread-Out Development** – A uniform spreading of development, on the other hand, provides fewer emergency landing spots and may increase the chance of someone on the ground being injured. On the plus side, a uniform distribution of development limits the maximum number of people who could possibly be in an impact area.

A compromise between these two strategies probably represents the optimum approach in most cases. This approach entails limiting the maximum occupancy level of a small area to double the overall criterion, but otherwise clustering development so as to provide the greatest amount of large open areas.

Uses in Structures versus Ones Not in Structures

Sometimes a distinction is made between the acceptable number of people per acre in land uses where people are *outdoors* versus those where the people are *in a building* or other enclosed area.

- **Outdoor Uses** – The theory is that people outdoors have more of a chance to see a plane coming as well as more directions in which they can move to vacate the impact area. A greater concentration of people thus is often considered acceptable for such land uses.

- **Uses in Buildings** – Buildings, on the other hand, provide substantial protection from the crash of a small airplane, particularly when the aircraft is still under control as it descends. If a fire subsequently ensues – historically, a relatively infrequent occurrence – it is unlikely to engulf the entire building instantly.

Taking both of these factors into account, the suggested strategy for airports used only by small aircraft, is to set the acceptable number of people in a given area equal for both uses in or not in structures. For airports heavily used by business jets and other medium to large aircraft, a greater restriction on the number of people in structures is appropriate in safety zones closest to runway ends.

MINIMIZING INJURY TO AIRCRAFT OCCUPANTS

In accidents involving an aircraft that is out of control as it descends, the character of the land uses below are not likely to have a significant effect on the survivability of the crash. However, as noted in Chapter 8, most aircraft mishaps involve situations in which the aircraft is descending, often without power, but otherwise under control. If the aircraft has sufficient altitude, the pilot has some choice as to where to attempt an emergency landing. Under these circumstances, the pilot of a disabled aircraft will, if possible, tend to aim the aircraft toward some form of open space when an off-airport emergency landing is inevitable.

This tendency forms the premise behind the primary form of land use control intended to minimize the severity of injury to aircraft occupants in the event of an off-airport emergency landing.

Open Space Requirements

Minimum Size

In theory, an open space does not have to be very large to enable a successful emergency landing. The objective is for the occupants to survive the accident with limited injury. Damage to the aircraft is irrelevant in these circumstances.

Note that among the accidents included in the *Handbook* database, the mean average swath length when the aircraft was under some pilot control is only 240 feet and the median is just 150 feet.

An area as small as 75 feet by 300 feet (about 0.5 acre or the size of a football field) can be adequate for a survivable emergency landing in a small plane if the area is relatively level and free of objects such as overhead lines and large trees and poles that can send the plane out of control at the last moment. Because the pilot's discretion in selecting an emergency landing site is reduced when the aircraft is at low altitude, open areas preferably should be larger and spaced more closely in those locations usually overflown at low altitude. The chance of a pilot seeing and successfully landing in a small open space also would be increased if there are more such spots from which to choose.

Total Percentage of Open Space in an Airport Vicinity

Determining the desirable number of open space sites or the total percentage of open space in an airport vicinity is a more difficult proposition than establishing the minimum size of individual areas. To assist in this decision, the following two observations are offered:

- The accident location patterns illustrated in Chapter 8 and the data presented in Table 8C reveal that accidents in which aircraft are under control are bunched relatively close to the runway ends – mostly within about 3,000 feet – both for arrivals and departures.
- The number of takeoff accident sites located a short distance laterally from the departure (climb-out) end of the runway may indicate that many pilots have either headed for an open space in that area or have attempted to turn around and land on the runway from the opposite direction, but not quite succeeded.

These observations lead to the following suggested criteria:

- **Runway Protection Zones** – Maintain all undeveloped land in open space in accordance with FAA standards.
- **Inner Safety Zones** – At general aviation airports, keep as much area as possible open within approximately 3,000 feet of runway ends. Strive for at least 50% usable open space (i.e., meeting the minimum size and design requirements) within an approximately 500-foot-wide

strip of land along the extended runway centerline; seek 25% to 30% usable open space within the overall inner safety zone.

- **Inner Turning Zone** — At least 15% to 20% of the zone should remain as open space.
- **Outer Safety Zones** — Maintain approximately 25% to 30% usable open space within the 500-foot-wide strip along the extended runway centerline and 10% to 15% overall.
- **Sideline Zone** — Adjacent to the runway ends and runway protection zones, 25% to 30% usable open space is a desirable objective.
- **Traffic Pattern Zone** — Elsewhere within the airport environment, 10% to 15% usable open space or an open area approximately every ¼ to ½ mile should be provided.

Preserving Open Space

The ability to successfully preserve airport-area open space, especially in the vicinity of urban airports, depends upon how two questions are answered:

- How is *open space* defined?
- What percentage of each remaining parcel must be devoted to open space?

An extended discussion of the significance of inverse condemnation to airport land use planning is found at the end of Chapter 3.

Attempts to maintain private land in open space without consideration of the answers to these questions could result in the actions being judged as inverse condemnation.

Defining Open Space

A definition of open space uses must be based upon a clear vision of the purpose of the open space. If the purpose of the open space is to provide emergency landing sites, the land would ideally be similar to a runway: free of structures, trees and water features; relatively smooth; and level.

In rural, agricultural areas, these open space criteria can be met with little restriction on the prevailing land use form. However, in urban locations, if open space is defined to mean *no development* of private property, the potential for an inverse condemnation suit is high. In urban areas, open space is generally only a viable land use designation if the property is in public ownership or its natural environmental constraints make development infeasible or inappropriate. If no development is the desired end, fee simple acquisition of the property would be the most appropriate implementation measure.

Alternatively, open space can be defined to include a range of uses which typically contain large amounts of land without structures and with low occupancy levels. In rural locations, agriculture (with some restrictions) is the ideal private use. However, in urban areas, there are only a few viable *private* uses which fit within the definition of open space.

- **Field Crops** — Flowers and specialty crops may be able to generate enough revenue to be supportable in an urban area. Many of these uses continue to operate in urbanized areas. A broader range of agricultural uses are practical in predominantly agricultural areas.
- **Golf Courses** — Given the high demand experienced by existing golf courses, a new golf course could be a profitable enterprise. However, golf courses require a substantial amount of land, particularly for a standard 18-hole facility.
- **Cemeteries** — Space for both human and pet cemeteries is extremely limited in highly urbanized locations; it is uncertain whether these uses would be feasible in a commercial sense, however.

Unfortunately, this list of open space uses is so limited that inverse condemnation would remain a serious concern. However, if *automobile parking lots* are included in the definition of acceptable private open space, the list becomes more realistic. Clearly, parking lots do not make the most desirable emergency landing sites, but they are generally preferable to buildings. Based upon anecdotal information, it appears that landing in a parking lot seldom injures those on the ground and is often survivable for occupants of light aircraft. Adding parking lots to the list of permitted open space uses could leave sufficient residual uses to avoid a taking if the open space zone is applied only to portions of the remaining open parcels. It might be possible to zone an entire parcel for open space uses if adjacent parcels are under the same ownership and a broad range of uses is permitted on the adjacent parcels.

Percentage of Open Space on a Parcel

Open space — in the form of landscaping — is a part of every new development project. It is appropriate to explore the potential for arranging the site design of new development near an airport to cluster the landscaping to create emergency landing sites. An alternative approach is to require greater amounts of landscaping than is typically required. Because the minimum size necessary for an emergency landing site is at least a half acre, this strategy is only viable on large parcels.

The more effective approach to preservation of open space is in conjunction with preparation and implementation of general plans and specific plans. Major roads (if trees, signs, poles, and wires are avoided in the center) and public open spaces (such as water bodies, scenic corridors, and parks) can often account for most if not all of the open space needs in the vicinity of an urban airport.

Success Rate for Aircraft to Reach an Open Space

A question raised by this whole premise is whether accidents in which the aircraft was under control occur in open spaces any more often than might randomly happen when the aircraft was not under control. Information on land uses at the accident site was not gathered as part of the research for the *Handbook* accident database. A general observation from the review of the Factual Records, though, is that the majority of the accidents took place in open areas simply because most airports are situated in rural locations.

Limited analysis of this question is contained in the Reid-Hillview Airport Study mentioned in Chapter 8 (Hodges & Shutt – 1991). One component of that study measured the percentage of open space around 12 urban airports and assessed the relative propensity of aircraft accidents to occur in those areas. Open space was defined according to the following criteria:

- **Limits of Airport Environs** – To provide some commonality among the airports, the environs examined for each airport were defined as being the area encompassed by the Federal Aviation Regulations Part 77 horizontal surface for utility-category (accommodating aircraft weighing up to 12,500 pounds), visual or nonprecision runways (i.e., all areas within 5,000 feet of the end of any runway's primary surface). The total airport environs acreages differ for each airport because of the differing lengths and configurations of the runways.

- **Land Use Categories** – Open space for each airport was determined by examination of aerial photographs. Four categories of open space were considered:

  - Agricultural and undeveloped lands.
  - Water bodies and flood plains.
  - Open parks, recreational facilities, and school grounds.
  - On-airport property.

  Only those open spaces larger than about 2 to 3 acres were included in the computations.

- **Other Characteristics** – No attempt was made to identify steep terrain, ditches, fences, posts, trees, or other such individual obstacles that may occur in the otherwise open areas. Roads and auto parking lots were not included in the tabulation.

The results indicated that open space comprises from as little as 5% to over 60% of the overall environs of the studied airports. The average for the 12 airports is 25%. For all but three of the airports, agricultural and undeveloped lands comprise the largest category of existing open space, thus posing the question of whether the land will remain open in the future.

A comparison between the aircraft accident sites and the open spaces around each of the 12 airports revealed that some 33% of the accidents appear to have occurred within these areas. Although this percentage is higher than the 25% figure that would be expected from a purely random distribution of accident locations in the airports' environs, it is not enough higher to be statistically conclusive. A much greater sampling of aircraft accident locations plus better data as to whether the accident sites were indeed in open areas would be necessary to provide a more definitive conclusion.

Nevertheless, in the absence of evidence indicating that airport area open space is not of value as a means of increasing the survivability of off-airport accidents, ALUCs are strongly encouraged to include open space criteria in their compatibility plans.

HAZARDS TO FLIGHT

Unlike the preceding land use characteristics which can only affect the *severity* of an aircraft accident (for better or worse), hazards to flight can be the *cause* of an accident. Hazards to flight fall into two basic categories:

- Obstructions to the airspace required for flight to, from, and around an airport; and
- Other forms of interference with safe flight, navigation, or communication.

Airspace Obstructions

The airspace needed for operation of aircraft around an airport is defined by Part 77 of the Federal Aviation Regulations and, for airports with instrument approaches, by the U.S. Standards for Terminal

Instrument Procedures (TERPS). In most circumstances, the latter is the less restrictive set of criteria.

Limiting the heights of structures to the heights indicated by the Part 77 surfaces provides an ample margin of safety for normal aircraft operations. The guidance provided by Part 77 is not absolute, however. Deviation from the Part 77 standards does not necessarily mean that a safety hazard exists, only that offending objects must be evaluated by the Federal Aviation Administration and that mitigative actions such as marking or lighting be taken if appropriate.

In some locations, such as adjacent to a runway, objects exceeding the Part 77 height limits may not be regarded as a hazard. On the other hand, tall objects in the approach corridors may pose risks even though they do not penetrate the defined Part 77 surfaces. Such objects also can adversely affect the minimum instrument approach altitudes allowed in accordance with TERPS standards.

Other Flight Hazards

Other land use characteristics can also affect flight safety. The characteristics can be *visual*, *electronic*, or *physical* in nature.

- **Visual Hazards** — Visual hazards include distracting lights (particularly lights which can be confused with airfield lights), glare, and sources of smoke.

- **Electronic Hazards** — Electronic hazards include any uses which interfere with aircraft instruments or radio communication.

- **Physical Hazards** — The principal physical hazards, other than the height of structures, are bird strikes. Although the risk of bird strikes is most serious along the corridors required for takeoffs and landings, the concern extends to elsewhere in the airport vicinity. Any land uses which can attract birds should be avoided, but those which are artificial attractors are particularly inappropriate because they generally need not be located near airports. Sanitary landfills are a primary example of the latter type of activity. The FAA recommends that such uses be kept at least 10,000 feet from any runway used by turbine-powered aircraft.

Part III

Appendices

Appendix A

State Laws Related to Airport Land Use Planning

Table of Contents

(as of July 1993)

AERONAUTICS LAW

PUBLIC UTILITIES CODE
Division 9 — Aviation
Part 1 — State Aeronautics Act
Chapter 4 — Airports and Air Navigation Facilities

Article 3.5
AIRPORT LAND USE COMMISSION

(As of July 1993)

21670. Creation; Membership; Selection

(a) The Legislature hereby finds and declares that:

(1) It is in the public interest to provide for the orderly development of each public use airport in this state and the area surrounding these airports so as to promote the overall goals and objectives of the California airport noise standards adopted pursuant to Section 21669 and to prevent the creation of new noise and safety problems.

(2) It is the purpose of this article to protect public health, safety, and welfare by ensuring the orderly expansion of airports and the adoption of land use measures that minimize the public's exposure to excessive noise and safety hazards within areas around public airports to the extent that these areas are not already devoted to incompatible uses.

(b) In order to achieve the purposes of this article, every county in which there is located an airport which is served by a scheduled airline may establish an airport land use commission. Every county, in which there is located an airport which is not served by a scheduled airline, but is operated for the benefit of the general public, may establish an airport land use commission, except that the board of supervisors for the county may, after consultation with the appropriate airport operators and affected local entities and after a public hearing, adopt a resolution finding that there are no noise, public safety, or land use issues affecting any airport in the county which require the creation of a commission and declaring the county exempt from that requirement. The board may, in this event, transmit a copy of the resolution to the Director of Transportation. For purposes of this section, "commission" means an airport land use commission. Each commission shall consist of seven members to be selected as follows:

(1) Two representing the cities in the county, appointed by a city selection committee comprised of the mayors of all the cities within that county, except that if there are

any cities contiguous or adjacent to the qualifying airport, at least one representative shall be appointed therefrom. If there are no cities within a county, the number of representatives provided for by subdivisions (2) and (3) shall each be increased by one.

(2) Two representing the county, appointed by the board of supervisors.

(3) Two having expertise in aviation, appointed by a selection committee comprised of the managers of all the public airports within that county.

(4) One representing the general public, appointed by the other six members of the commission.

(c) Public officers, whether elected or appointed, may be appointed and serve as members of the commission during their terms of public office.

(d) Each member shall promptly appoint a single proxy to represent the member in commission affairs and to vote on all matters when the member is not in attendance. The proxy shall be designated in a signed written instrument which shall be kept on file at the commission offices, and the proxy shall serve at the pleasure of the appointing member. A vacancy in the office of proxy shall be filled promptly by appointment of a new proxy.

(e) A person having an "expertise in aviation" means a person who, by way of education, training, business, experience, vocation, or avocation has acquired and possesses particular knowledge of, and familiarity with, the function, operation, and role of airports, or is an elected official of a local agency which owns or operates an airport. The commission shall be constituted pursuant to this section on and after March 1, 1988.

21670.1. Action by Designated Body Instead of Commission

(a) Notwithstanding any provisions of this article, if the board of supervisors and the city selection committee of mayors in any county each makes a determination by a majority vote that proper land use planning can be accomplished through the actions of an appropriate designated body, then such body shall assume the planning responsibilities of an airport land use commission as provided for in this article, and a commission need not be formed in that county.

(b) A body designated pursuant to subdivision (a) which does not include among its membership at least two members having an expertise in aviation, as defined in subdivision (e) of Section 21670, shall, when acting in the capacity of an airport land use commission, be augmented so that the body, as augmented, will have at least two members having that expertise. The commission shall be constituted pursuant to this section on and after March 1, 1988.

21670.2. Applicability to Counties Having over 4 Million Population

(a) Sections 21670 and 21670.1 do not apply to the County of Los Angeles. In that county, the county regional planning commission has the responsibility for coordinating the airport planning of public agencies within the county. In instances where impasses result relative to this planning, an appeal may be made to the county regional planning commission by any public agency involved. The action taken by the county regional planning commission on such an appeal may be overruled by a four-fifths vote of the governing body of a public agency whose planning led to the appeal.

(b) By January 1, 1992, the county regional planning commission shall adopt the comprehensive land use plans required pursuant to Section 21675.

(c) Sections 21675.1, 21675.2, and 21679.5 do not apply to the County of Los Angeles until January 1, 1992. If the comprehensive land use plans required pursuant to Section 21675 are not adopted by the county regional planning commission by January 1, 1992, Sections 21675.1 and 21675.2 shall apply to the County of Los Angeles until the plans are adopted.

21671. Airports Owned by a City, District, or County; Appointment of Certain Members by Cities and Counties

In any county where there is an airport operated for the general public which is owned by a city or district in another county or by another county, one of the representatives provided by paragraph (1) of subdivision (b) of Section 21670 shall be appointed by the city selection committee of mayors of the cities of the county in which the owner of that airport is located, and one of the representatives provided by paragraph (2) subdivision (b) of Section 21670 shall be appointed by the board of supervisors of the county in which the owner of that airport is located.

21671.5. Term of Office; Removal of Members; Vacancies; Compensation; Staff Assistance; Meetings

(a) Except for the terms of office of the members of the first commission, the term of office for each member shall be four years and until the appointment and qualification of his or her successor. The members of the first commission shall classify themselves by lot so that the term of office of one member is one year, of two members is two years, of two members is three years, and of two members if four years. The body which originally appointed a member whose term has expired shall appoint his or her successor for a full term of four years. Any member may be removed at any time and without cause by the body appointing him or her. The expiration date of the term of office of each member shall be the first Monday in May in the year in which his or her term is to expire. Any vacancy in the membership of the commission shall be filled for the unexpired term by appointment by the body which originally appointed the member whose office has become vacant. The chairperson of the commission shall be selected by the members thereof.

(b) Compensation, if any, shall be determined by the board of supervisors.

(c) Staff assistance, including the mailing of notices and the keeping of minutes, and necessary quarters, equipment, and supplies shall be provided by the county. The usual and necessary expenses of the commission shall be a county charge.

(d) Notwithstanding any other provisions of this article, the commission shall not employ any personnel either as employees or independent contractors without the prior approval of the board of supervisors.

(e) The commission shall meet at the call of the commission chairperson or at the request of the majority of the commission members. A majority of the commission members shall constitute a quorum for the transaction of business. No action shall be taken by the commission except by the recorded vote of a majority of the full membership.

(f) The commission may establish a schedule of fees necessary to comply with this article. Those fees shall be charged to the proponents of actions, regulations, or permits, shall not exceed the estimated reasonable cost of providing the service, and shall be imposed pursuant to Section 66016 of the Government Code. Except as provided in subdivision (g), after June 30, 1991, a commission which has not adopted the comprehensive land use plan required by Section 21675 shall not charge fees pursuant to this subdivision until the commission adopts the plan.

(g) In any county which has undertaken by contract or otherwise completed land use plans for at least one-half of all public use airports in the county, the commission may continue to charge fees necessary to comply with this article until June 30, 1992, and, if the land use plans are complete by that date, may continue charging fees after June 30, 1992. If the land use plans are not complete by June 30, 1992, the commission shall not charge fees pursuant to subdivision (f) until the commission adopts the land use plans.

21672. Rules and Regulations

Each commission shall adopt rules and regulations with respect to the temporary disqualification of its members from participating in the review or adoption of a proposal because of conflict of interest and with respect to appointment of substitute members in such cases.

21673. Initiation of Proceedings for Creation by Owner of Airport

In any county not having a commission or a body designated to carry out the responsibilities of a commission, any owner of a public airport may initiate proceedings for the creation of a commission by presenting a request to the board of supervisors that a commission be created and showing the need therefor to the satisfaction of the board of supervisors.

21674. Powers and Duties

The commission has the following powers and duties, subject to the limitations upon its jurisdiction set forth in Section 21676:

(a) To assist local agencies in ensuring compatible land uses in the vicinity of all new airports and in the vicinity of existing airports to the extent that the land in the vicinity of those airports is not already devoted to incompatible uses.

(b) To coordinate planning at the state, regional, and local levels so as to provide for the orderly development of air transportation, while at the same time protecting the public health, safety, and welfare.

(c) To prepare and adopt an airport land use plan pursuant to Section 21675.

(d) To review the plans, regulations, and other actions of local agencies and airport operators pursuant to Section 21676.

(e) The powers of the commission shall in no way be construed to give the commission jurisdiction over the operation of any airport.

(f) In order to carry out its responsibilities, the commission may adopt rules and regulations consistent with this article.

21674.5. Training of Airport Land Use Commission's Staff

(a) The Department of Transportation shall develop and implement a program or programs to assist in the training and development of the staff of airport land use commissions, after consulting with airport land use commissions, cities, counties, and other appropriate public entities.

(b) The training and development program or programs are intended to assist the staff of airport land use commissions in addressing high priority needs, and may include, but need not be limited to, the following:

  (1) The establishment of a process for the development and adoption of comprehensive land use plans.

  (2) The development of criteria for determining airport land use planning boundaries.

  (3) The identification of essential elements which should be included in the comprehensive plans.

(4) Appropriate criteria and procedures for reviewing proposed developments and determining whether proposed developments are compatible with the airport use.

(5) Any other organizational, operational, procedural, or technical responsibilities and functions which the department determines to be appropriate to provide the commission staff and for which it determines there is a need for staff training and development.

(c) The department may provide training and development programs for airport land commission staff pursuant to this section by any means it deems appropriate. Those programs may be presented in any of the following ways:

(1) By offering formal courses or training programs.

(2) By sponsoring or assisting in the organization and sponsorship of conferences, seminars, or other similar events.

(3) By producing and making available written information.

(4) Any other feasible method of providing information and assisting in the training and development of airport land use commission staff.

21675. Land Use Plan

(a) Each commission shall formulate a comprehensive land use plan that will provide for the orderly growth of each public airport and the area surrounding the airport within the jurisdiction of the commission, and will safeguard the general welfare of the inhabitants within the vicinity of the airport and the public in general. The commission plan shall include and shall be based on a long-range master plan or an airport layout plan, as determined by the Division of Aeronautics of the Department of Transportation, that reflects the anticipated growth of the airport during at least the next 20 years. In formulating a land use plan, the commission may develop height restrictions on buildings, specify use of land, and determine building standards, including soundproofing adjacent to airports, within the planning area. The comprehensive land use plan shall be reviewed as often as necessary in order to accomplish its purposes, but shall not be amended more than once in any calendar year.

(b) The commission may include, within its plan formulated pursuant to subdivision (a), the area within the jurisdiction of the commission surrounding any federal military airport for all the purpose specified in subdivision (a). This subdivision does not give the commission any jurisdiction or authority over the territory or operations of any military airport.

(c) The planning boundaries shall be established by the commission after hearing and consultation with the involved agencies.

(d) The commission shall submit to the Division of Aeronautics of the department one copy of the plan and each amendment to the plan.

(e) If a comprehensive land use plan does not include the matters required to be included pursuant to this article, the Division of Aeronautics of the department shall notify the commission responsible for the plan.

21675.1. Adoption of Land Use Plan

(a) By June 30, 1991, each commission shall adopt the comprehensive land use plan required pursuant to Section 21675, except that any county which has undertaken by contract or otherwise completed land use plans for at least one-half of all public use airports in the county, shall adopt that plan on or before June 30, 1992.

(b) Until a commission adopts a comprehensive land use plan, a city or county shall first submit all actions, regulations, and permits within the vicinity of a public airport to the commission for review and approval. Before the commission approves or disapproves any actions, regulations, or permits, the commission shall give the public notice in the same manner as the city or county is required to give for those actions, regulations, or permits. As used in this section, "vicinity" means land which will be included or reasonably could be included within the plan. If the commission has not designated a study area for the plan, then "vicinity" means land within two miles of the boundary of a public airport.

(c) The commission may approve an action, regulation, or permit if it finds, based on substantial evidence in the record, all of the following:

(1) The commission is making substantial progress toward the completion of the plan.

(2) There is a reasonable probability that the action, regulation, or permit will be consistent with the plan being prepared by the commission.

(3) There is little or no probability of substantial detriment to or interference with the future adopted plan if the action, regulation, or permit is ultimately inconsistent with the plan.

(d) If the commission disapproves an action, regulation, or permit, the commission shall notify the city or county. The city or county may overrule the commission, by a two-thirds vote of its governing body, if it makes specific findings that the proposed action, regulation, or permit is consistent with the purposes of this article, as stated in Section 21670.

(e) If a city or county overrules the commission pursuant to subdivision (d), that action shall not relieve the city or county from further compliance with this article after the commission adopts the plan.

(f) If a city or county overrules the commission pursuant to subdivision (d) with respect to a publicly owned airport that the city or county does not operate, the operator of the airport shall be immune from liability for damages to property or personal injury from the city's or county's decision to proceed with the action, regulation, or permit.

(g) A commission may adopt rules and regulations which exempt any ministerial permit for single-family dwellings from the requirements of subdivision (b) if it makes the findings required pursuant to subdivision (c) for the proposed rules and regulations, except that the rules and regulations may not exempt either of the following:

(1) More than two single-family dwellings by the same applicant within a subdivision prior to June 30, 1991.

(2) Single-family dwellings in a subdivision where 25 percent or more of the parcels are undeveloped.

21675.2. Approval or Disapproval of Actions, Regulations, or Permits

(a) If a commission fails to act to approve or disapprove any actions, regulations, or permits within 60 days of receiving the request pursuant to Section 21675.1, the applicant or his or her representative may file an action pursuant to Section 1094.5 of the Code of Civil Procedure to compel the commission to act, and the court shall give the proceedings preference over all other actions or proceedings, except previously filed pending matters of the same character.

(b) The action, regulation, or permit shall be deemed approved only if the public notice required by this subdivision has occurred. If the applicant has provided seven days advance notice to the commission of the intent to provide public notice pursuant to this subdivision, then, not earlier than the date of the expiration the time limit established by Section 21675.1, an applicant may provide the required public notice. If the applicant chooses to provide public notice, that notice shall include a description of the proposed action, regulation, or permit substantially similar to the descriptions which are commonly used in public notices by the commission, the name and address of the commission, and a statement that the action, regulation, or permit shall be deemed approved if the commission has not acted within 60 days. If the applicant has provided the public notice specified in this subdivision, the time limit for action by the commission shall be extended to 60 days after the public notice is provided. If the applicant provides notice pursuant to this section, the commission shall refund to the applicant any fees which were collected for providing notice and which were not used for that purpose.

(c) Failure of an applicant to submit complete or adequate information pursuant to Sections 65943 to 65946, inclusive, of the Government Code, may constitute grounds for disapproval of actions, regulations, or permits.

(d) Nothing in this section diminishes the commission's legal responsibility to provide, where applicable, public notice and hearing before acting on an action, regulation, or permit.

21676. Review of Local General Plans

(a) Each local agency whose general plan includes areas covered by an airport land use commission plan shall, by July 1, 1983, submit a copy of its plan or specific plans to the airport land use commission. The commission shall determine by August 31, 1983, whether the plan or plans are consistent or inconsistent with the commission's plan. If the plan or plans are inconsistent with the commission's plan, the local agency shall be notified and that local agency shall have another hearing to reconsider its plans. The local agency may overrule the commission after such a hearing by a two-thirds vote of its governing body if it makes specific findings that the proposed action is consistent with the purposes of this article stated in Section 21670.

(b) Prior to the amendment of a general plan or specific plan, or the addition or approval of a zoning ordinance or building regulation within the planning boundary established by the airport land use commission pursuant to Section 21675, the local agency shall first refer the proposed action to the commission. If the commission determines that the proposed action is inconsistent with the commission's plan, the referring agency shall be notified. The local agency may, after a public hearing, overrule the commission by a two-thirds vote of its governing body if it makes specific findings that the proposed action is consistent with the purposes of this article stated in Section 21670.

(c) Each public agency owning any airport within the boundaries of an airport land use commission plan shall, prior to modification of its airport master plan, refer such proposed change to the airport land use commission. If the commission determines that the proposed action is inconsistent with the commission's plan, the referring agency shall be notified. The public agency may, after a public hearing, overrule the commission by a two-thirds vote of its governing body if it makes specific findings that the proposed action is consistent with the purposes of this article stated in Section 21670.

(d) Each commission determination pursuant to subdivision (b) or (c) shall be made within 60 days from the date of referral of the proposed action. If a commission fails to make the determination within that period, the proposed action shall be deemed consistent with the commission's plan.

21676.5. Review of Local Plans

(a) If the commission finds that a local agency has not revised its general plan or specific plan or overruled the commission by a two-thirds vote of its governing body after making specific findings that the proposed action is consistent with the purposes of this article as stated in Section 21670, the commission may require the local agency submit all subsequent actions, regulations, and permits to the commission for review until its general plan or specific plan is revised or the specific findings are made. If, in the determination of the commission, an action, regulation, or permit of the local agency is inconsistent with the commission plan, the local agency shall be notified and that local agency shall hold a hearing to reconsider its plan. The local agency may overrule the commission after hearing by a two-thirds vote of its governing body if it makes specific findings that the proposed action is consistent with the purposes of this article as stated in Section 21670.

(b) Whenever the local agency has revised its general plan or specific plan or has overruled the commission pursuant to subdivision (a), the proposed action of the local agency shall not be subject to further commission review, unless the commission and the local agency agree that the individual projects shall be reviewed by the commission.

21677. Marin County Override Provisions

Notwithstanding Section 21676, any public agency in the County of Marin may overrule the Marin County Airport Land Use Commission by a majority vote of its governing body.

21678. Airport Owner's Immunity

With respect to a publicly owned airport that a public agency does not operate, if the public agency pursuant to Section 21676 or 21676.5 overrides a commission's action or recommendation, the operator of the airport shall be immune from liability for damages to property or personal injury caused by or resulting directly or indirectly from the public agency's decision to override the commission's action or recommendation.

21679. Court Review

(a) In any county in which there is no airport land use commission or other body designated to assume the responsibilities of an airport land use commission, or in which the commission or other designated body has not adopted an airport land use plan, an interested party may initiate proceedings in a court of competent jurisdiction to postpone the effective date of a zoning change, a zoning variance, the issuance of a permit, or the adoption of a regulation by a local agency, which directly affects the use of land within one mile of the boundary of a public airport within the county.

(b) The court may issue an injunction which postpones the effective date of the zoning change, zoning variance, permit, or regulation until the governing body of the local agency which took the action does one of the following:

(1) In the case of an action which is a legislative act, adopts a resolution declaring that the proposed action is consistent with the purposes of this article stated in Section 21670.

(2) In the case of an action which is not a legislative act, adopts a resolution making findings based on substantial evidence in the record that the proposed action is consistent with the purposes of this article stated in Section 21670.

(3) Rescinds the action.

(4) Amends its action to make it consistent with the purposes of this article stated in Section 21670, and complies with either paragraph (1) or (2) of this subdivision, whichever is applicable.

(c) The court shall not issue an injunction pursuant to subdivision (b) if the local agency which took the action demonstrates that the general plan and any applicable specific plan of the agency accomplishes the purposes of an airport land use plan as provided in Section 21675.

(d) An action brought pursuant to subdivision (a) shall be commenced within 30 days of the decision or within the appropriate time periods set by Section 21167 of the Public Resources Code, whichever is longer.

(e) If the governing body of the local agency adopts a resolution pursuant to subdivision (b) with respect to a publicly owned airport that the local agency does not operate, the operator of the airport shall be immune from liability for damages to property or personal injury from the local agency's decision to proceed with the zoning change, zoning variance, permit, or regulation.

(f) As used in this section, "interested party" means any owner of land within two miles of the boundary of the airport or any organization with a demonstrated interest in airport safety and efficiency.

21679.5. Deferral of Court Review

(a) Until June 30, 1991, no action pursuant to Section 21679 to postpone the effective date of a zoning change, a zoning variance, the issuance of a permit, or the adoption of a regulation by a local agency, directly affecting the use of land within one mile of the boundary or a public airport, shall be commenced in any county in which the commission or other designated body has not adopted an airport land use plan, but is making substantial progress toward the completion of the plan.

(b) If a commission has been prevented from adopting the comprehensive land use plan by June 30, 1991, or if the adopted plan could not become effective, because of a lawsuit involving the adoption of the plan, the June 30, 1991 date in subdivision (a) shall be extended by the period of time during which the lawsuit was pending in a court of competent jurisdiction.

(c) Any action pursuant to Section 21679 commenced prior to January 1, 1990, in a county in which the commission or other designated body has not adopted an airport land use plan, but is making substantial progress toward the completion of the plan, which has not proceeded to final judgment, shall be held in abeyance until June 30, 1991. If the commission or other designated body does not adopt an airport land use plan on or before June 30, 1991, the plaintiff or plaintiffs may proceed with the action.

(d) An action to postpone the effective date of a zoning change, a zoning variance, the issuance of a permit, or the adoption of a regulation by a local agency, directly affecting the use of land within one mile of the boundary of a public airport for which an airport land use plan has not been adopted by June 30, 1991, shall be commenced within 30 days of June 30, 1991, or within 30 days of the decision by the local agency, or within the appropriate time periods set by Section 21167 of the Public Resources Code, whichever date is later.

AERONAUTICS LAW

PUBLIC UTILITIES CODE
Division 9, Part 1, Chapter 4

Article 2.7
REGULATION OF OBSTRUCTIONS
(excerpts)

21655. Proposed Site for Construction of State Building Within Two Miles of Airport; Investigation and Report; Expenditure of State Funds

Notwithstanding any other provision of law, if the proposed site of any state building or other enclosure is within two miles, measured by air line, of that point on an airport runway, or runway proposed by an airport master plan, which is nearest the site, the state agency or office which proposes to construct the building or other enclosure shall, before acquiring title to property for the new state building or other enclosure site or for an addition to a present site, notify the Department of Transportation, in writing, of the proposed acquisition. The department shall investigate the proposed site and, within 30 working days after receipt of the notice, shall submit to the state agency or office which proposes to construct the building or other enclosure a written report of the investigation and its recommendations concerning acquisition of the site.

If the report of the department does not favor acquisition of the site, no state funds shall be expended for the acquisition of the new state building or other enclosure site, or the expansion of the present site, or for the construction of the state building or other enclosure, provided that the provisions of this section shall not affect title to real property once it is acquired.

AERONAUTICS LAW

PUBLIC UTILITIES CODE
Division 9, Part 1, Chapter 4

Article 3
REGULATION OF AIRPORTS
(excerpts)

21661.5 Approval of Construction Plans; Submission of Plan to Airport Land Use Commission

No political subdivision, any of its officers or employees, or any person may submit any application for the construction of a new airport to any local, regional, state, or federal agency unless the plan for such construction is first approved by the board of supervisors of the county, or the city council of the city, in which the airport is to be located and unless the plan is submitted to the appropriate commission exercising powers pursuant to Article 3.5 (commencing with Section 21670) of Chapter 4 of Division 9, and acted upon by such commission in accordance with the provisions of such article.

21664.5 Approval of Sites; Amended Airport Permits; Airport Expansion Defined

An amended airport permit shall be required for every expansion of an existing airport. An applicant for an amended airport permit shall comply with each requirement of this article pertaining to permits for new airports. The department may by regulation provide for exemptions from the operation of the section pursuant to Section 21661, except that no exemption shall be made limiting the applicability of subdivision (e) of Section 21666, pertaining to environmental considerations, including the requirement for public hearings in connection therewith.

As used in this section, "airport expansion" includes any of the following:

(a) The acquisition of clear zones or of any interest in land for the purpose of any other expansion as set forth in this section.

(b) The construction of a new runway.

(c) The extension or realignment of an existing runway.

(d) Any other expansion of the airport's physical facilities for the purpose of accomplishing or which are related to the purpose of subdivision (a), (b), or (c).

This section shall not apply to any expansion of an existing airport if the expansion commenced on or prior to the effective date of this section and the expansion met the approval on or prior to such effective date of each governmental agency which by law required such approval.

PLANNING AND ZONING LAW

GOVERNMENT CODE
Title 7 — Planning and Land Use
Division 1 — Planning and Zoning
Chapter 3 — Local Planning

Article 5
AUTHORITY FOR AND SCOPE OF GENERAL PLANS
(excerpts)

65302.3. General and Applicable Specific Plans; Consistency with Airport Land Use Plans; Amendment; Nonconcurrence Findings

(a) The general plan, and any applicable specific plan prepared pursuant to Article 8 (commencing with Section 65450), shall be consistent with the plan adopted or amended pursuant to Section 21675 of the Public Utilities Code.

(b) The general plan, and any applicable specific plan, shall be amended, as necessary, within 180 days of any amendment to the plan required under Section 21675 of the Public Utilities Code.

(c) If the legislative body does not concur with any of the provisions of the plan required under Section 21675 of the Public Utilities Code, it may satisfy the provisions of this section by adopting findings pursuant to Section 21676 of the Public Utilities Code.

PLANNING AND ZONING LAW

GOVERNMENT CODE
Title 7 — Planning and Land Use
Division 1 — Planning and Zoning
Chapter 4.5 — Review and Approval of Development Projects

Article 3
APPLICATION FOR DEVELOPMENT PROJECTS

Note: *The following government code sections are referenced in Section 21675.2(c) of the ALUC statutes.*

65943. Completeness of Application; Determination; Time; Specification of Parts not Complete and Manner of Completion

Not later than 30 calendar days after any public agency has received an application for a development project, such agency shall determine in writing whether such application is complete and shall immediately transit such determination to the applicant for the development project. If such written determination is not made within 30 days after receipt of the application, the application shall be deemed complete for purposes of this chapter. In the event that the application is determined not to be complete, the agency's determination shall specify those parts of the application which are incomplete and shall indicate the manner in which they can be made complete.

65944. Acceptance of Application as Complete; Requests for Additional Information; Restrictions; Clarification, Amplification, Correction, etc; Prior to Notice of Necessary Information

(a) After a public agency accepts an application as complete, the agency shall not subsequently request of an applicant any new or additional information which was not specified in the list prepared pursuant to Section 65940. The agency may, in the course of processing the application, request the applicant to clarify, amplify, correct, or otherwise supplement the information required for the application.

(b) The provisions of subdivision (a) shall not be construed as requiring an applicant to submit with his or her initial application the entirety of the information which a public agency may require in order to take final action on the application. Prior to accepting an application, each public agency shall inform the applicant of any information included in the list prepared pursuant to Section 65940 which will subsequently be required from the applicant in order to complete final action on the application.

(c) This section shall not be construed as limiting the ability of a public agency to request and obtain information which may be needed in order to comply with the provisions of Division 13 (commencing with Section 21000) of the Public Resources Code.

65945. Notice of Proposal to Adopt or Amend Certain Plans or Ordinances by City or County, Fee; Subscription to Periodically Updated Notice as Alternative, Fee

(a) At the time of filing an application for a development permit with a city or county, the city or county shall inform the applicant that he or she may make a written request to retrieve notice from the city or county of a proposal to adopt or amend any of the following plans or ordinances:

(1) A general plan.
(2) A specific plan.
(3) A zoning ordinance.
(4) An ordinance affecting building permits or grading permits.

The applicant shall specify, in the written request, the types of proposed action for which notice is requested. Prior to taking any of those actions, the city or county shall give notice to any applicant who has requested notice of the type of action proposed and whose development project is pending before the city or county if the city or county determines that the proposal is reasonably related to the applicant's request for the development permit. Notice shall be given only for those types of actions which the applicant specifies in the request for notification.

The city or county may charge the applicant for a development permit, to whom notice is provided pursuant to this subdivision, a reasonable fee not to exceed the actual cost of providing that notice. If a fee is charged pursuant to this subdivision, the fee shall be collected as part of the application fee charged for the development permit.

(b) As an alternative to the notification procedure prescribed by subdivision (a), a city or county may inform the applicant at the time of filing an application for a development permit that he or she may subscribe to a periodically updated notice or set of notices from the city or county which lists pending proposals to adopt or amend any of the plans or ordinances specified in subdivision (a), together with the status of the proposal and the date of any hearings thereon which have been set.

Only those proposals which are general, as opposed to parcel-specific in nature, and which the city or county determines are reasonably related to requests for development permits, need be listed in the notice. No proposals shall be required to be listed until such time as the first public hearing thereon has been set. The notice shall be updated and mailed at least once every six weeks; except that a notice need not be updated and mailed until a change in its contents is required.

The city or county may charge the applicant for a development permit, to whom notice is provided pursuant to this subdivision, a reasonable fee not to exceed the actual cost of providing that notice, including the costs of updating the notice, for the length of time the applicant requests to be sent the notice or notices.

65945.3. Notice of Proposal to Adopt or Amend Rules or Regulations Affecting Issuance of Permits by Local Agency other than City or County; Fee

At the time of filing an application for a development permit with a local agency, other than a city or county, the local agency shall inform the applicant that he or she may make a written request to receive notice of any proposal to adopt or amend a rule or regulation affecting the issuance of development permits.

Prior to adopting or amending any such rule or regulation, the local agency shall give notice to any applicant who has requested such notice and whose development project is pending before the agency if the local agency determines that the proposal is reasonably related to the applicant's request for the development permit.

The local agency may charge the applicant for a development permit, to whom notice is provided pursuant to this section, a reasonable fee not to exceed the actual cost of providing that notice. If a fee is charged pursuant to this section, the fee shall be collected as part of the application fee charged for the development permit.

65945.5. Notice of Proposal to Adopt or Amend Regulation Affecting Issuance of Permits and Which Implements Statutory Provision by State Agency

At the time of filing an application for a development permit with a state agency, the state agency shall inform the applicant that he or she may make a written request to receive notice of any proposal to adopt or amend a regulation affecting the issuance of development permits and which implements a statutory provision.

Prior to adopting or amending any such regulation, the state agency shall give notice to any applicant who has requested such notice and whose development project is pending before the state agency if the state agency determines that the proposal is reasonably related to the applicant's request for the development permit.

65945.7. Actions, Inactions, or Recommendations Regarding Ordinances, Rules or Regulations; Invalidity or Setting Aside Ground of Error Only if Prejudicial

No action, inaction, or recommendation regarding any ordinance, rule, or regulation subject to this Section 65945, 65945.3, or 65945.5 by any legislative body, administrative body, or the officials of any state or local agency shall be held void or invalid or be set aside by any court on the ground of any error, irregularity, informality, neglect, or omission (hereinafter called "error") as to any matter pertaining to notices, records, determinations, publications, or any matters of procedure whatever, unless after an examination of the entire case, including evidence, the court shall be of the opinion that the error complained of was prejudicial, and that by reason of such error that party complaining or appealing sustained and suffered substantial injury, and that a different result would have been probable if such error had not occurred or existed. There shall be no presumption that error is prejudicial or that injury was done if error is shown.

65946. Consolidated Project Information Form; Submission; Application Forms; Fees

(a) The Office of Planning and Research, in consultation with the Resources Agency, and the Environmental Protection Agency, shall develop a consolidated project information form which may be used by applicants for development projects. This form shall provide for sufficient information to allow state agencies to determine whether or not the project will be subject to the requirements for a permit from the agency.

(b) Applicants for development projects may submit the form provided by subdivision (a) to the Office of Planning and Research for distribution to state agencies which have permit responsibilities for development projects. The Office of Planning and Research shall send copies of the form to such agencies within three days of receipt.

(c) Within 30 days of receipt of the form, each agency shall notify the Office of Planning and Research in writing whether or not a permit from that agency may be required and it shall send the Office of Planning and Research the appropriate permit application forms.

(d) Within 15 days of receipt of the completed form from such agencies, the Office of Planning and Research shall notify the applicant for a development project in writing of any permits required for the project specified, and it shall send the applicant the appropriate permit application forms received from the state agencies.

(e) The Office of Planning and Research, in consultation with the Resources Agency, and the Environmental Protection Agency, shall develop a consolidated project application form which may be used by applicants for development projects. The application form shall contain sufficient information to allow state agencies, departments, commissions, boards, and other administrative divisions within the agencies, to act on a permit for the project.

(f) Each state agency may develop an agency consolidated project application form which may be used by applicants for development projects. The application form shall contain sufficient information to allow the agency and any department, commission, board, and other administrative division within that agency to act on a permit.

(g) The Office of Planning and Research may charge an applicant for a development project a fee not to exceed the estimated reasonable cost of providing the services performed pursuant to this section. Before levying or changing a fee, the Office of Planning and Research shall adopt or amend regulations pursuant to the Administrative Procedures Act, Chapter 3.5 (commencing with Section 11340) of Part 1 of Division 3 of Title 2. The Office of Planning and Research shall make available to the public upon request data indicating the amount of cost, or estimated cost, required to provide the service and the revenue sources anticipated to provide the service, including general or special fund revenues.

EDUCATION CODE
Title 2 — Elementary and Secondary Education
Division 3 — Local Administration
Part 23 — School Facilities

Article 1
GENERAL PROVISIONS
(excerpts)

39005. Site near Airport; Requirements

(a) The requirements set forth in this section are designed to promote the safety of pupils, comprehensive community planning, and greater educational usefulness of school sites.

(b) Before acquiring title to property for a new school site, or for an addition to a present site, as to any site that is within two miles, measured by air line, of any point on an airport runway or a potential runway included in an airport master plan that is nearest the site, the governing board of each school district, including any district government by a city board of education, shall give the Department of Transportation written notice of the proposed acquisition and shall submit any information required by the department. If the Department of Transportation is no longer in operation, the school district governing board shall, in lieu of notifying the Department of Transportation, notify the United States Department of Transportation or any other appropriate agency, in writing, of the proposed acquisition for the purpose of obtaining from the department or other agency any information or assistance that it may desire to give.

The Department of Transportation shall investigate the proposed site and, within 30 working days after receipt of the notice, shall submit to the government board a written report and its recommendations concerning acquisition of the site. The governing board shall not acquire title to the property until the report of the Department of Transportation has been received. If the report does not favor the acquisition of the property for a school site or an addition to a present school site, the governing board shall not acquire title to the property until 30 days after the department's report is received and until the department's report has been read, at a public hearing duly called after 10 days' notice published once in a newspaper of general circulation within the school district or, if there is no such newspaper, in a newspaper of general circulation within the county in which the property is located.

39006. Notice and Public Hearing

Notwithstanding Section 39005, immediately after receiving notice of a proposed acquisition of property that is within two miles, measured by air line, of that point on an airport boundary that is nearest the site, the Department of Transportation shall make an investigation and report to the school district governing board within 25 days after receipt of the notice. As part of the investigation, the Department of Transportation shall give notice thereof to the owner and operator of the airport who shall be granted the opportunity to comment upon the proposed school site.

Notwithstanding Section 39005, if the report of the Department of Transportation required by that section does not favor the acquisition of the property for a school site, or an addition to a present school site, the governing body shall not acquire title to the property until 30 days after the department's report is received and until the department's report has been read at a public hearing duly called after 10 days' notice by publication in a newspaper of general circulation within the school district or, if there is no such newspaper, in a newspaper of general circulation within the county in which the property is located.

39007. Proposed Site within Two Miles of Airport Runway

(a) Except as provided in subdivision (b), if the Department of Transportation in its report submitted to a school district governing board pursuant to Section 39005 or 39006, does not favor acquisition of a proposed site that is within two miles of the center line of an active runway, no state funds, school district funds, or funds of the county in which the district lies shall be granted, apportioned, allowed, or expended, in connection with that site, for school site acquisition or school building construction, or for expansion of existing sites and buildings.

(b) This section does not apply to sites acquired prior to January 1, 1966, nor to any additions or extensions to those sites.

(c) If the recommendation of the Department of Transportation is unfavorable, the recommendation shall not be overruled without the express approval of the State Allocation Board.

EDUCATION CODE
Title 3 — Postsecondary Education
Division 7 — Community Colleges
Part 49 — Community Colleges, Education Facilities
Chapter 1 — School Sites

Article 2
SCHOOL SITES
(excerpts)

81033. Investigation: Geologic and Soil Engineering Studies; Airport in Proximity

(c) To promote the safety of students, comprehensive community planning, and greater educational usefulness of community college sites, the governing board of each community college district, if the proposed site is within two miles, measured by air line, of that point on an airport runway, or a runway proposed by an airport master plan, which is nearest the site and excluding them if the property is not so located, before acquiring title to property for a new community college site or for an addition to a present site, shall give the board of governors notice in writing of the proposed acquisition and shall submit any information required by the board of governors.

Immediately after receiving notice of the proposed acquisition of property which is within two miles, measured by air line, of that point on an airport runway, or a runway proposed by an airport master plan, which is nearest the site, the board of governors shall notify the Division of Aeronautics of the Department of Transportation, in writing, of the proposed acquisition. The Division of Aeronautics shall make an investigation and report to the board of governors within 30 working days after receipt of the notice. If the Division of Aeronautics is no longer in operation, the board of governors shall, in lieu of notifying the Division of Aeronautics, notify the Federal Aviation Administration or any other appropriate agency, in writing, of the proposed acquisition for the purpose of obtaining from the authority or other agency such information or assistance as it may desire to give.

The board of governors shall investigate the proposed site and within 35 working days after receipt of the notice shall submit to the governing board a written report and its recommendations concerning acquisition of the site. The governing board shall not acquire title to the property until the report of the board of governors has been received. If the report does not favor the acquisition of the property for a community college site or an addition to a present community college site, the governing board shall not acquire title to the property until 30 days after the department's report is received and until the board of governors' report has been read at a public hearing duly called after 10 days' notice published once in a newspaper of general circulation within the community college district, or if there is no such newspaper, then in a newspaper of general circulation within the county in which the property is located.

(d) If, with respect to a proposed site located within two miles of an operative airport runway, the report of the board of governors submitted to a community college district governing board under subdivision (c) does not favor the acquisition of the site on the sole or partial basis of the unfavorable recommendation of the Division of Aeronautics of the Department of Transportation, no state agency or officer shall grant, apportion, or allow to such community college district for expenditure in connection with that site, any state funds otherwise made available under any state law whatever for a community college site acquisition or college building construction, or for expansion of existing sites and buildings, and no funds of the community college district or of the county in which the district lies shall be expended for such purposes; provided that provisions of this section shall not be applicable to sites acquired prior to January 1, 1966, nor any additions or extensions to such sites.

If the recommendations of the Division of Aeronautics is unfavorable, such recommendations shall not be overruled without the express approval of the board of governors and the State Allocation Board.

LEGISLATIVE HISTORY SUMMARY

PUBLIC UTILITIES CODE
Sections 21670 et seq.
Airport Land Use Commission Statutes

1967 Original ALUC statute enacted.
- Establishment of ALUCs required in each county containing a public airport served by a certificated air carrier.
- The purpose of ALUCs is indicated as being to make recommendations regarding height restrictions on buildings and the use of land surrounding airports.

1970 Assembly Bill 1856 (Badham) Chapter 1182, Statutes of 1970 — Adds provisions which:
- Require ALUCs to prepare comprehensive land use plans.
- Require such plans to include a long-range plan and to reflect the airport's forecast growth during the next 20 years.
- Require ALUC review of airport construction plans (Section 21661.5).
- Exempt Los Angeles County from the requirement of establishing an ALUC.

1971 The function of ALUCs is restated as being to require new construction to conform to Department of Aeronautics standards.

1973 ALUCs are permitted to establish compatibility plans for military airports.

1982 Assembly Bill 2920 (Rogers) Chapter 1041, Statutes of 1982 — Adds major changes which:
- More clearly articulate the purpose of ALUCs.
- Eliminate reference to "achieve by zoning."
- Require consistency between local general and specific plans and airport land use commission plans; the requirements define the process for attaining consistency, they do not establish standards for consistency.
- Eliminate the requirement for proposed individual development projects to be referred to an ALUC for review once local general/specific plans are consistent with the ALUC's plan.
- Require that local agencies make findings of fact before overriding an ALUC decision.
- Change the vote required for an override from 4/5 to 2/3.

1984 Assembly Bill 3551 (Mountjoy) Chapter 1117, Statutes of 1984 — Amends the law to:
- Require ALUCs in all counties having an airport which serves the general public unless a county and its cities determine an ALUC is not needed.
- Limit amendments to compatibility plans to once per year.
- Allow individual projects to continue to be referred to the ALUC by agreement.

- Extend immunity to airports if an ALUC action is overridden by a local agency not owning the airport.
- Provide state funding eligibility for preparation of compatibility plans through the Regional Transportation Improvement Program process.

1987 Senate Bill 633 (Rogers) Chapter 1018, Statutes of 1987 — Makes revisions which:
- Require that a designated body serving as an ALUC include two members having "expertise in aviation."
- Allows an interested party to initiate court proceedings to postpone the effective date of a local land use action if a compatibility plan has not been adopted.
- Delete *sunset* provisions contained in certain clauses of the law.
- Allows reimbursement for ALUC costs in accordance with the Commission on State Mandates.

1989 Senate Bill 255 (Bergeson) Chapter 54, Statutes of 1989 —
- Sets a requirement that comprehensive land use plans be completed by June 1991.
- Establishes a method for compelling ALUCs to act on matters submitted for review.
- Allows ALUCs to charge fees for review of projects.
- Suspends any lawsuits that would stop development until the ALUC adopts its plan or until June 1, 1991.

1989 Senate Bill 235 (Alquist) Chapter 788, Statutes of 1989 — Appropriates $3,672,000 for the payment of claims to counties seeking reimbursement of costs incurred during fiscal years 1985-86 through 1989-90 pursuant to state-mandated requirement (Chapter 1117, Statutes of 1984) for creation of ALUCs in most counties. This statute was repealed in 1993.

1990 Assembly Bill 4164 (Mountjoy) Chapter 1008, Statutes of 1990 — Adds section 21674.5 requiring the Division of Aeronautics to develop and implement a training program for ALUC staffs.

1990 Assembly Bill 4265 (Clute) Chapter 563, Statutes of 1990 — With the concurrence of the Division of Aeronautics, allows ALUCs to use an airport layout plan, rather than a long-range airport master plan, as the basis for preparation of a compatibility plan.

1990 Senate Bill 1288 (Beverly) Chapter 54, Statutes of 1990 — Amends Section 21670.2 to give Los Angeles County additional time to prepare compatibility plans and meet other provisions of the ALUC statutes.

1991 Senate Bill 532 (Bergeson) Chapter 140, Statutes of 1991 —
- Allows counties having half of their compatibility plans completed or under preparation by June 30, 1991, an additional year to complete the remainder.
- Allows ALUCs to continue to charge fees under these circumstances.
- Fees may be charged only until June 30, 1992, if plans are not completed by then.

1993 Senate Bill 443 (Committee on Budget and Fiscal Review) Chapter 59, Statutes of 1993 — Amends Section 21670(b) to make the formation of ALUCs permissive rather than mandatory as of June 30, 1993. (Note: Section 21670.2 which assigns responsibility for coordinating the airport planning of public agencies in Los Angeles County is not affected by this amendment.)

Appendix B

Accident Data Research Methodology

Appendix B

Accident Data Research Methodology

Data Sources Initially Investigated

As discussed in Chapter 8, data regarding virtually all of the characteristics pertinent to analysis of off-airport accidents is contained in the computer-based accident briefs covering all accidents investigated by the National Transportation Safety Board. Information regarding the *precise location* of each accident relative to the runway used is the key exception. To the extent that exact location information is recorded by the NTSB, it is included only in the individual Factual Record assembled for each accident. Depending upon the nature of the accident, the Factual Record may be anywhere from a dozen to hundreds of pages long. This data is maintained on microfiche and is not available in computerized form.

Preliminary investigation by the study team into the Factual Records for a test group of accidents revealed that many contain the necessary location data, but most do not. Also, it was recognized that the process of extracting this information from the records would be a time-consuming one.

Other possible sources of information were therefore investigated to determine whether any could be more efficiently researched or would yield more complete or more accurate data than the NTSB records. The sources reviewed included:

- **Managers of Individual Airports** — Direct contact with the management of individual airports was the principal alternative initially considered. A major difficulty with this approach is that the completeness of the accident records maintained by different airports varies greatly. The number of years recorded, the level of detail, and the accuracy of the data from these sources would thus be inconsistent. Time-consuming follow-up letters and phone calls would be necessary in order to clarify the information received or to get any response at all. Also, correlating individual accident information obtained from airport managers with other categories of data readily available only in NTSB records would be difficult.

- **Local Newspapers** — Information from this source is essentially limited to published reports and pictures. As protection against possible erosion of first amendment rights, unpublished notes and photographs are not released to the public, even under court order. The probability of published stories or photographs adding to the information available from other sources is small.

- **Local Police and Fire Department Records** — A check with several California emergency agencies regarding specific accidents within their jurisdiction yielded little in the way of official (written) information other than that which is already included in the Factual Report. The only way this source could be useful would be to contact the individuals who went out on call and ask them to try to pinpoint the accident site.

- **State Aeronautics Offices** — Of the fifty states, only seven (Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, Ohio, and Rhode Island) do any of their own investigating. Even among these seven, the investigations are usually quite limited and often done for a specific purpose (i.e., Massachusetts checks to make sure that the aircraft owner is insured or has sufficient net worth to cover damages).

- **Aircraft Owners and Pilots Association** — This organization relies almost entirely on the FAA and the NTSB for the information they collect and publish regarding accidents. There is no new or enhanced information available from this source.

- **Airline Pilots Association** — The union for airline pilots is involved in investigations of commercial air carrier accidents only and would be of no help in general aviation accident locations. Their reports on commercial accidents would shed no new light on location.

- **Aircraft Insurance Companies** — A check with two of the major general aviation insurance companies (USAIG and Associated Aviation Insurance) yielded little in the way of useful results. Except in cases where location is useful in assessing fault (such as defective navigational aid or cockpit instrument) specific accident location is not of interest, and therefore, not included. Even in cases where accurate site data is given, two problems arise. First, finding the cases that would be of use would require a hand search through individual accident reports. Second, it would probably be difficult to obtain permission to go through the files as the information is considered proprietary and also could expose the company to lawsuits.

The conclusion reached from the review of these alternative data sources was that each could provide some useful information, but — for the purposes of ascertaining accident location data — none would be as complete, accurate, or accessible as the NTSB Factual Reports.

Scope of Research

Beyond the principal requirement for precise accident location data, various decisions were necessary in order to define the scope of the research effort. Some of these parameters were decided by the Division of Aeronautics and the study team at the outset of the research effort; others were modified in response to the outcome of the early phases of the process.

- **Definition of Airport Vicinity** — Although the fundamental interest of the study is on off-airport accidents, an accident occurring say 2,000 feet from the end of a runway may be within the boundaries of a large airport, but well beyond the property line of a smaller facility. Therefore, for the purposes of the analysis, *off-airport* was broadened to include any accidents not confined to the immediate vicinity of the runway (generally defined as Federal Aviation Regulations Part 77 primary surface), even if the accident site is on property actually owned by the airport. At the outer edge, a 5 mile radius — measured from the airport center in accordance with the NTSB data format — was selected as the limits of the airport vicinity. It is recognized that, at this distance from an airport, some of the accidents included may more properly be defined as en route rather than airport-related.

- **Accidents versus Incidents** – The NTSB defines an aircraft *accident* as an occurrence in which people on board or on the ground sustained serious or fatal injuries or in which the aircraft incurred substantial damage to the extent that it could no longer be considered airworthy. Other mishaps are classified as *incidents*. The NTSB and/or the FAA may conduct preliminary investigations into incidents to determine if they qualify as accidents. However, the extensive records maintained and compiled for accidents are not available for incidents. Given that the NTSB was selected as the data source for the current research effort, it was necessary to exclude incidents from the database. (See the Glossary, Appendix G, for a complete definition of *aircraft accident*.)

- **Aircraft Types** – Initially, all categories of civilian-use airplanes – airline and general aviation – were to be included in the database. Very few airline aircraft accident records were actually found, however. These were eliminated from the completed database because of the statistical bias they could give to some of the data (especially with regard to the number of injuries). Helicopters and other types of aircraft are omitted because of their markedly different operational characteristics. Accidents involving military and other government aircraft are not investigated by the NTSB and therefore are excluded from the database as well.

- **Data Categories** – Although the data of central interest to the research effort is the accident location information, other categories of data also were determined to be important to the subsequent analysis of the accidents' geographic distribution pattern. Many of the data categories selected for inclusion in the database were chosen with the thought that they might prove to be significant variables affecting where accidents occur. A complete list of the categories included in the database is included in Exhibit B–1. A description of each category and the manner in which the data was obtained or determined is noted as well.

- **Time Frame Covered** – The time period to be included within the research effort was at first planned to cover a minimum of 10 years, beginning with 1980 and extending to the most recently available data. However, the format of the NTSB's computer records essential to the initial step of the investigation was changed in 1983 and the earlier format was found to be less readily usable for the purposes of the project. The database therefore extends from 1983 to 1991.

- **States Included** – To enable statistically significant analysis of various subsets of accident points, a target of 500 accident records was set as the goal for the final database. Initially, it was anticipated that a database of this size could be obtained by review of accidents from just the 4 to 8 *sunbelt* states which generate the highest volumes of aircraft operations. However, a trial run of the process found a high rate of records which do not contain sufficiently accurate locational data. This factor, together with the reduced time frame, necessitated extending the research scope to include all 50 states.

Summary of Research Methodology

The task of gathering the desired data was accomplished by the University of California, Berkeley, Institute of Transportation Studies working as a member of the study team. The data gathering process evolved to some extent even after the basic approach and scope of the research were decided. Three major steps were involved, each with several components:

- **Review Briefs of All Accidents** — First, a computer listing of all aircraft accident records for the selected time period was obtained from the NTSB in *minibrief* format. This listing contained information on approximately 12,700 accidents. Each brief was then reviewed and an assessment made as to whether its location appeared to fall within the airport vicinity range defined for the research. This process narrowed the number of accidents fitting the defined parameters to approximately 2,450, not quite 20% of the total.

- **Review of Selected Accident Factual Records** — Next, microfiche copies of the complete Factual Record for each of the selected accidents were ordered. These records were then scanned to determine whether the necessary location information was included. Location data could be found in any of several sections of the record including the investigators notes, the pilot's statement, or statements of witnesses or emergency response personnel. Only about one record in six was determined to contain usable data.

- **Preparation of Database** — Finally, location information on each accident was entered into a computer database along with the data in the other categories which had been selected. Frequently, the Factual Records identify the accident sites with reference to local streets. In order to establish the distance of the accident site from the airport runway involved, local street maps often had to be obtained and measurements taken from them. At this time, the various other categories of data for each accident were also added to the database.

As used for the analyses presented in this *Handbook*, the complete database contains 400 entries.

FILE DATA
- *Date*
- *NTSB File Number*
- *Airport Name*
- *City*
  Associated city of airport involved.
- *State*

AIRCRAFT TYPE
- *Manufacturer*
- *Model*
- *Weight (Maximum Gross Takeoff Weight)*
  Obtained from *Janes Aircraft* or other sources.
- *Number of Engines*

FLIGHT INFORMATION
- *Phase of Flight (Arrival/Departure)*
  An arrival becomes a departure when:
  - A missed approach is executed during an instrument approach.
  - The aircraft leaves the ground on a touch-and-go.
  - The pilot aborts a VFR approach while under control.

  A departure becomes an arrival when:
  - The aircraft is established downwind on a touch-and-go.
  - The aircraft is under control and established inbound on a return to the airfield, whether in an emergency or otherwise.
- *Takeoff Roll Start*
  Point where takeoff roll began if not at end of runway.
- *Approach Type (VFR/IFR)*
  Flight rules category being followed at time of accident.
- *Time of Day*

AIRPORT CONDITIONS
- *Weather (VMC/IMC)*
  Weather conditions at time of accident.
- *Visibility*
  Horizontal visibility at time of accident.
- *Light (Day/Night)*

RUNWAY INFORMATION
- *Runway Number*
  Duty runway used or intended to be used.
- *Runway Heading*
  Magnetic bearing of duty runway.
- *Runway Length*
- *Runway Width*
- *Approach Type (Visual/Nonprecision/Precision)*
  Runway capability, regardless of approach type in use during accident.
- *Pattern Direction (Left/Right)*

Table B-1

Database Categories

ACCIDENT LOCATION

- *X Coordinate Distance*
  Distance left (–) or right (+) of runway centerline to initial point of ground or object contact.
- *Y Coordinate Distance*
  For arrivals: distance from landing threshold to initial point of ground or object contact.
  (–) if site is prior to threshold; (+) if beyond landing threshold.
  For departures: distance from start of takeoff roll to initial point of ground contact.
- *Distance from Departure End of Runway*
  For departures only: distance along runway centerline from departure (climb-out) end of runway to initial point of ground or object contact (Y Coordinate Distance minus Runway Length).

ACCIDENT CHARACTERISTICS

- *Pilot Control (Some/None)*
  A somewhat subjective assessment of whether the pilot had some or no control over the path of the aircraft at the time of descent.
  Some control is judged to have occurred when the pilot materially and successfully affected the location of ground contact. For example, the pilot may have stated in record that he saw a spot for a forced landing and put down in that spot.
  No control of the aircraft is assumed to have existed if, for example:
  - The aircraft is observed descending in a near vertical spin.
  - The accident investigation determines that the aircraft was out of control when it crashed.
  - The aircraft was on an instrument approach, unless there is evidence that the aircraft broke free of the clouds or fog and the pilot intentionally put down in a particular location.
- *Swath Length*
  Distance from initial point of contact with the ground or an object on the ground to the point where the aircraft came to a stop.
- *In-Flight Collision with Object (Yes/No)*
  Indicates whether the aircraft struck an object on the ground while still in flight.
- *Collision Factor*
  Indicates whether the collision affected where the aircraft ultimately crashed.

ON-BOARD INJURIES

- *Number of Fatal Injuries*
- *Number of Serious Injuries*
- *Number of Minor Injuries*

ON-GROUND INJURIES

- *Number of Fatal Injuries*
- *Number of Serious Injuries*
- *Number of Minor Injuries*

DAMAGE

- *To Aircraft (Destroyed/Substantial)*
- *On Ground*
  Obstructs struck and extent of damage.

OTHER

- *Notes*
  Miscellaneous pertinent information not included in other categories.

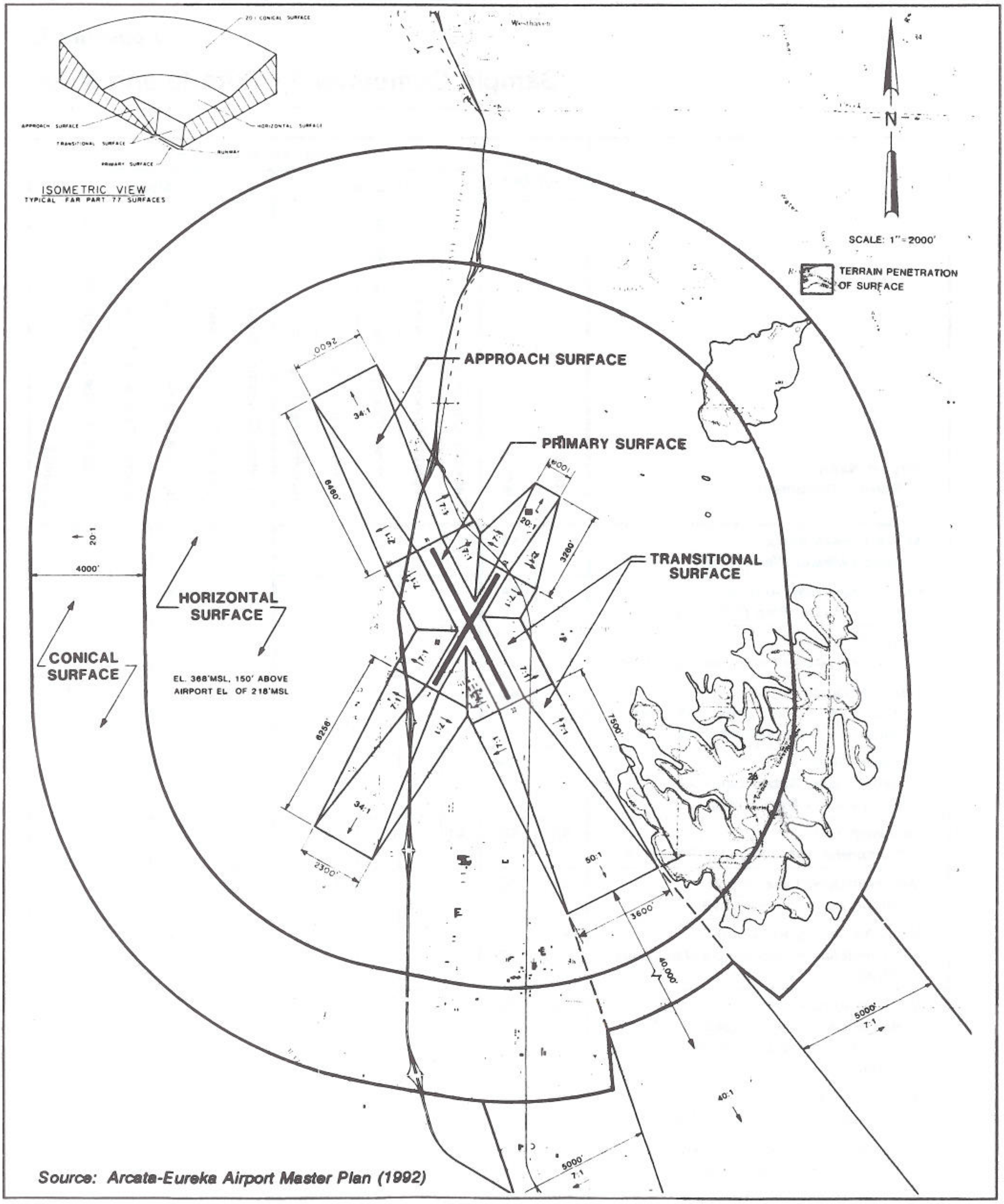
Table B-1 - Continued

Appendix C

Sample Compatibility Criteria and Maps

Sample Compatibility Criteria and Maps

Airport Name / *Source Document*	Exhibit Number		Concept Illustrated										
			Tables					*Maps*					
	Tables	*Maps*	Separate Concerns: Noise	Separate Concerns: Safety	Combined Concerns: Noise and Safety	Detailed Land Use List	Performance-Based List	Separate Concerns: Noise	Separate Concerns: Safety	Separate Concerns: Airspace	Separate Concerns, Single Map	Combined Concerns: Noise and Safety	Detailed Land Uses
Arcata-Eureka Airport *Airport Master Plan (1992)*		1A								X			
Hanford Municipal Airport *Airport Master Plan (1993 Draft)*		2A								X			
Hemet-Ryan Airport *Comprehensive Land Use Plan (1992)*	3A	3B		X					X				
Imperial County Airport *Airport Land Use Compatibility Plan: Imperial County Airports (1991)*	4A	4B	X					X					
Lampson Field *Lake County Airport Land Use Compatibility Plan (1992)*	5A	5B			X		X					X	
Lindbergh Field *Comprehensive Land Use Plan (1991)*	6A	6B	X			X		X					
Mammoth-June Lake Airport *Airport Land Use Plan (1987)*	7A	7B				X							X
Naval Air Facility El Centro *Air Installation Compatible Use Zones (1990)*	8A	8B 8C		X		X			X	X			
Nut Tree Airport *Airport/Land Use Compatibility Plan: City of Vacaville Density Standards (1988)*	9A	9B			X	X						X	
Riverside Municipal Airport *Comprehensive Land Use Plan (1993)*	10A	10B 10C	X	X		X	X				X		
Sacramento Metropolitan Airport *Comprehensive Land Use Plan (1993)*	11A	11B		X		X			X				
San Luis Obispo County Airport *Airport Land Use Plan (1979)*	12A	12B			X	X						X	
Sonoma Valley Airport *Sonoma County Airport Land Use Policy Plan (1981)*	13A	13B		X			X		X				

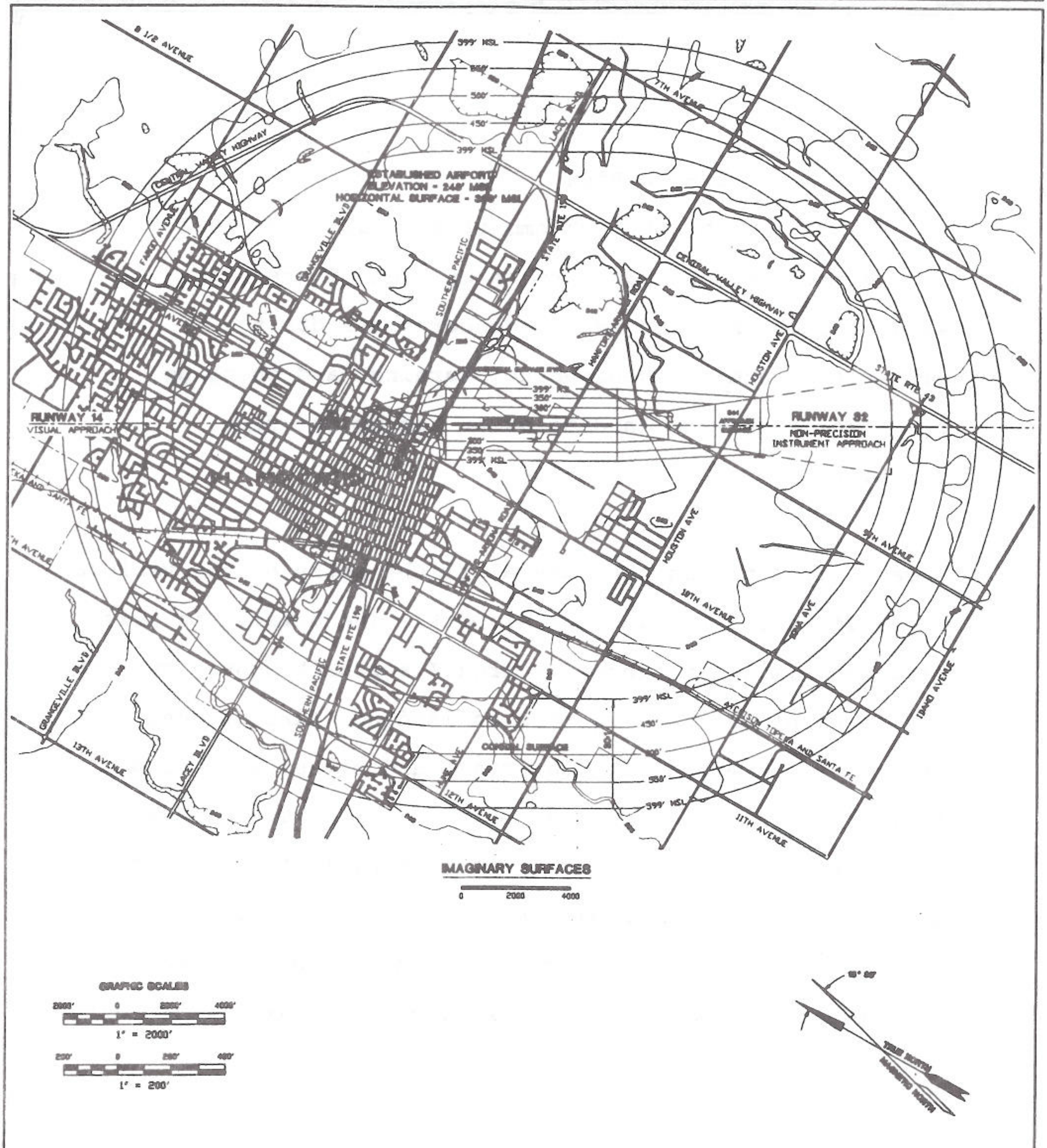


Source: Arcata-Eureka Airport Master Plan (1992)

Exhibit C-1A

Airspace Plan

Arcata-Eureka Airport



Source: Hanford Municipal Airport Master Plan (1993 Draft)

Exhibit C-2A

Airport Airspace Plan

Hanford Municipal Airport

B. AREA II: Area of High Risk

An area defined by the subcommittee on July 29, 1982, and revised October 1982, to be an area of greatest safety concerns. The safety concerns are due to aircraft ascending, descending, turning, and changing power settings when landing at or taking off from the airport.

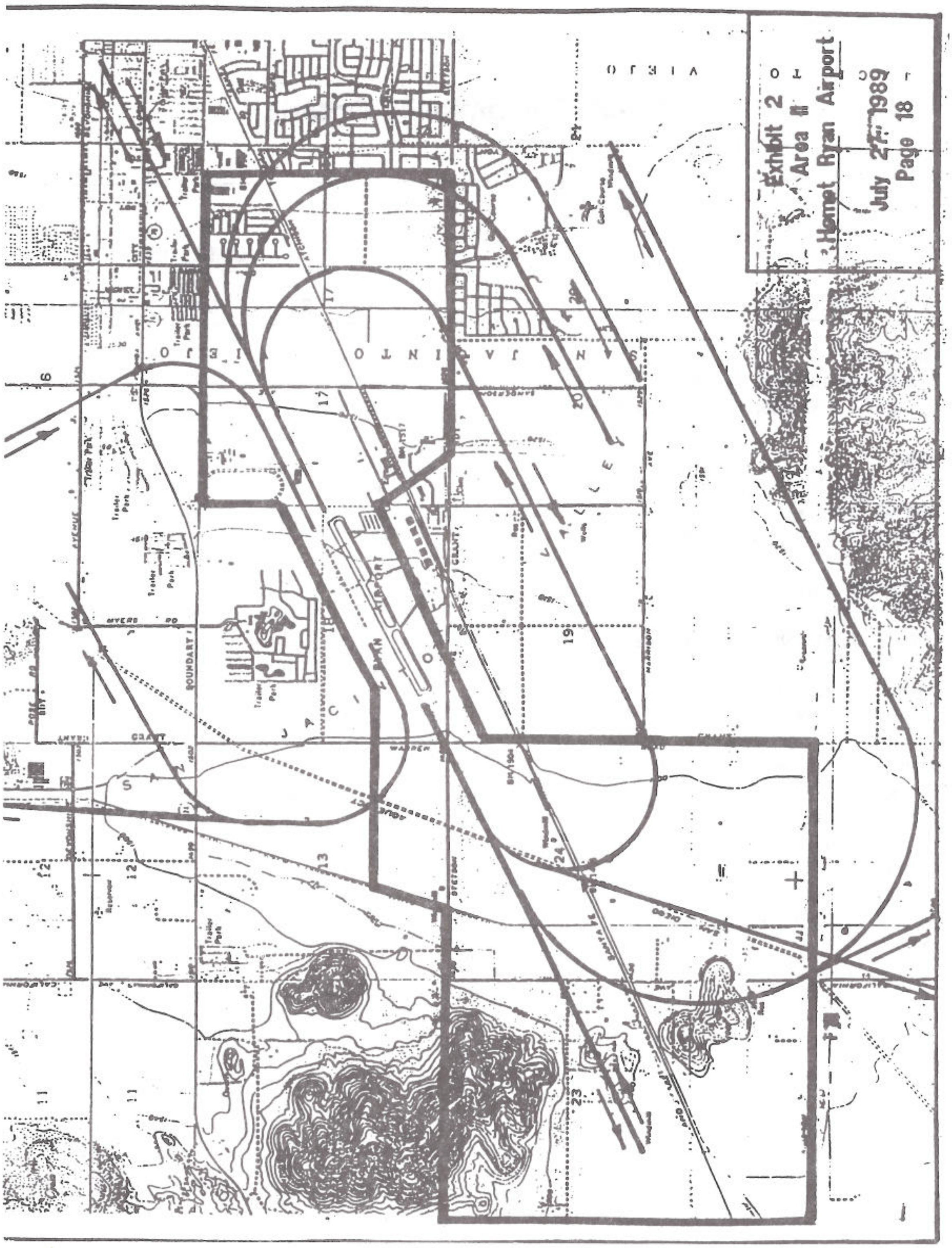
Area II illustrates the general flight paths of the various types of aircraft using the airport. The hazards in this area are similar to those in Area I approach zones, but the influence of the same factors of landing, take-off and noise are not as severe and the aircraft are higher in altitude; therefore, the policies are not as severe. The boundaries of the area were established to coincide as much as possible to areas where aircraft would be in the landing - take-off generalized pattern and would be turning and applying or reducing power (again, higher risk of something happening).

Source: Hemet-Ryan Airport Comprehensive Land Use Plan (1992)

Exhibit C-3A

Area of High Risk

Hemet-Ryan Airport



Source: Hemet-Ryan Airport Comprehensive Land Use Plan (1992)

Exhibit C-3B

Airport Safety Area II

Hemet-Ryan Airport

Noise Compatibility Criteria

LAND USE CATEGORY	CNEL, dBA 50-55	55-60	60-65	65-70	70-75
Residential					
single family, nursing homes, mobile homes	+	o	–	– –	– –
multi-family, apartments, condominiums	++	+	o	– –	– –
Public					
schools, libraries, hospitals	+	o	–	– –	– –
churches, auditoriums, concert halls	+	o	o	–	– –
transportation, parking, cemeteries	++	++	++	+	o
Commercial and Industrial					
offices, retail trade	++	+	o	o	–
service commercial, wholesale trade, warehousing, light industrial	++	++	+	o	o
general manufacturing, utilities, extractive industry	++	++	++	+	+
Agricultural and Recreational					
cropland	++	++	++	++	+
livestock breeding	++	+	o	o	–
parks, playgrounds, zoos	++	+	+	o	–
golf courses, riding stables, water recreation	++	++	+	o	o
outdoor spectator sports	++	+	+	o	–
amphitheaters	+	o	–	– –	– –

Source: Airport Land Use Compatibility Plan: Imperial County Airports (1991)

Exhibit C-4A

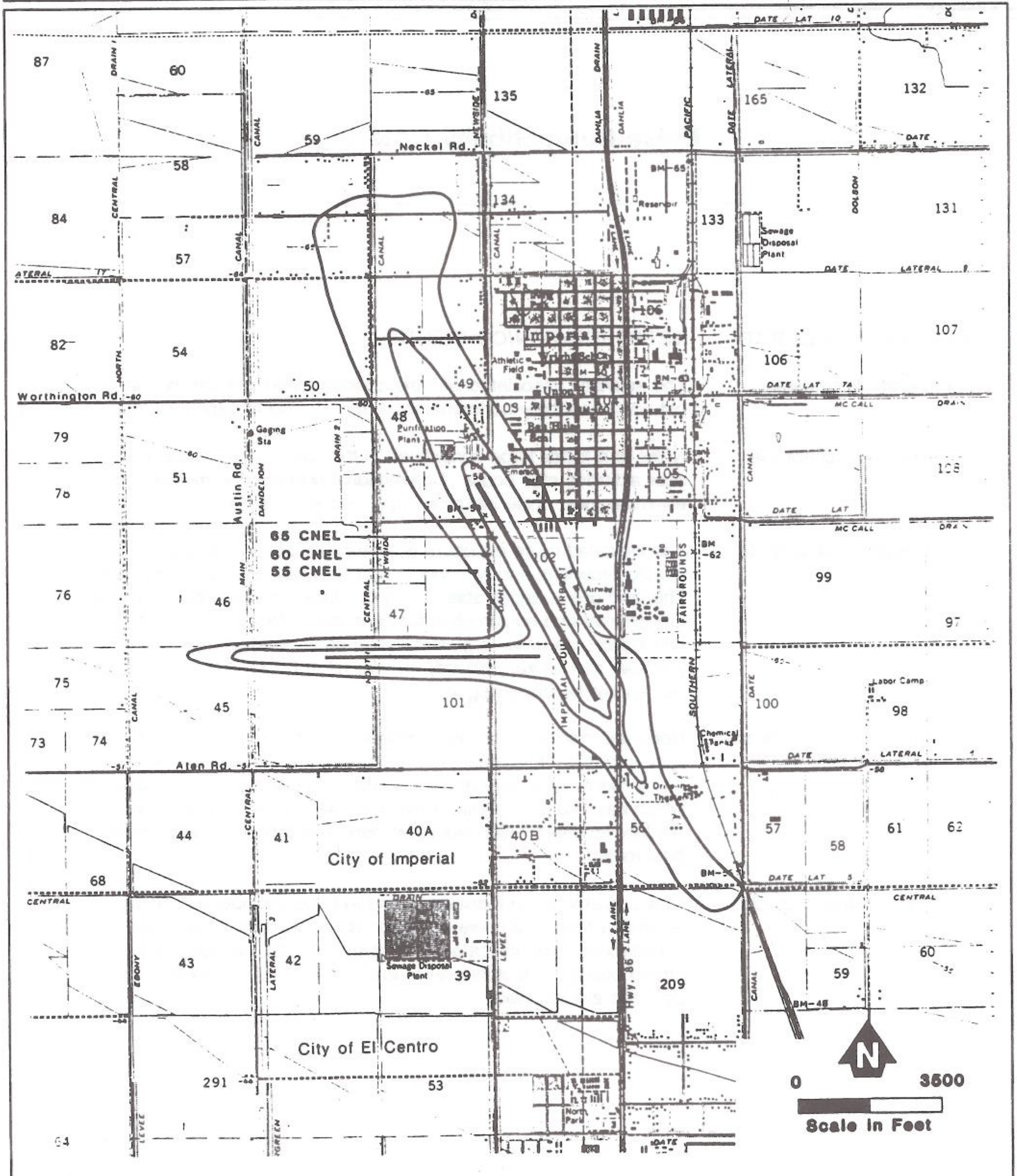
Noise Compatibility Criteria

Imperial County Airport

Noise Compatibility Criteria

LAND USE AVAILABILITY	INTERPRETATION/COMMENTS
++ Clearly Acceptable	The activities associated with the specified land use can be carried out with essentially no interference from the noise exposure.
+ Normally Acceptable	Noise is a factor to be considered in that slight interference with outdoor activities may occur. Conventional construction methods will eliminate most noise intrusions upon indoor activities.
o Marginally Acceptable	The indicated noise exposure will cause moderate interference with outdoor activities and with indoor activities when windows are open. The land use is acceptable on the conditions that outdoor activities are minimal and construction features which provide sufficient noise attenuation are used (e.g., installation of air conditioning so that windows can be kept closed). Under other circumstances, the land use should be discouraged.
– Normally Unacceptable	Noise will create substantial interference with both outdoor and indoor activities. Noise intrusion upon indoor activities can be mitigated by requiring special noise insulation construction. Land uses which have conventionally constructed structures and/or involve outdoor activities which would be disrupted by noise should generally be avoided.
– – Clearly Unacceptable	Unacceptable noise intrusion upon land use activities will occur. Adequate structural noise insulation is not practical under most circumstances. The indicated land use should be avoided unless strong overriding factors prevail and it should be prohibited if outdoor activities are involved.

Exhibit C-4A Continued



Source: Airport Land Use Compatibility Plan: Imperial County Airports (1991)

Exhibit C-4B

Noise Impact Area

Imperial County Airport

Compatibility Criteria

Lake County Airport Land Use Compatibility Plan

Zone	Location	Impact Elements	Maximum Densities		Required Open Land[3]
			Residential (du/ac)[1]	Other Uses (people/ac)[2]	
A	Runway Protection Zone or within Building Restriction Line	• High risk • High noise levels	0	10	All Remaining
B1	Approach/Departure Zone and Adjacent to Runway	• Substantial risk – aircraft commonly below 400 ft. AGL or within 1,000 ft. of runway • Substantial noise	0.1	60	30%
B2	Extended Approach/Departure Zone	• Significant risk – aircraft commonly below 800 ft. AGL • Significant noise	0.5	60	30%
C	Common Traffic Pattern	• Limited risk – aircraft at or below 1,000 ft. AGL • Frequent noise intrusion	5	150	15%
D	Other Airport Environs	• Negligible risk • Potential for annoyance from overflights	No Limit	No Limit	No Requirement

Zone	Additional Criteria		Examples	
	Prohibited Uses	Other Development Conditions	Normally Acceptable Uses[4]	Uses Not Normally Acceptable[5]
A	• All structures except ones with location set by aeronautical function • Assemblages of people • Objects exceeding FAR Part 77 height limits • Hazards to flight[6]	• Dedication of avigation easement	• Aircraft tiedown apron • Pastures, field crops, vineyards • Automobile parking	• Heavy poles, signs, large trees, etc.
B1 and B2	• Schools, day care centers, libraries • Hospitals, nursing homes • Highly noise-sensitive uses • Storage of highly flammable materials • Hazards to flight[6]	• Locate structures maximum distance from extended runway centerline • Minimum NLR[7] of 25 dBA in residential and office buildings • Dedication of avigation easement	• Uses in Zone A • Any agricultural use except ones attracting bird flocks • Warehousing, truck terminals • Single-story offices	• Residential subdivisions • Intensive retail uses • Intensive manufacturing or food processing uses • Multiple story offices • Hotels and motels
C	• Schools • Hospitals, nursing homes • Hazards to flight[6]	• Dedication of overflight easement for residential uses	• Uses in Zone B • Parks, playgrounds • Low-intensity retail, offices, etc. • Low-intensity manufacturing, food processing • Two-story motels	• Large shopping malls • Theaters, auditoriums • Large sports stadiums • Hi-rise office buildings
D	• Hazards to flight[6]	• Deed notice required for residential development	• All except ones hazardous to flight	

Source: Lake County Airport Land Use Compatibility Plan (1992)

Exhibit C-5A

Compatibility Criteria

Lampson Field

Compatibility Criteria

Lake County Airport Land Use Compatibility Plan

NOTES

1 Residential development should not contain more than the indicated number of dwelling units per gross acre. Clustering of units is encouraged as a means of meeting the Required Open Land requirements.

2 The land use should not attract more than the indicated number of people per acre at any time. This figure should include all individuals who may be on the property (e.g., employees, customers/visitors, etc.). These densities are intended as general planning guidelines to aid in determining the acceptability of proposed land uses.

3 See Policy 3.2.5.

4 These uses typically can be designed to meet the density requirements and other development conditions listed.

5 These uses typically do not meet the density and other development conditions listed. they should be allowed only if a major community objective is served by their location in this zone and no feasible alternative location exists.

6 See Policy 3.3.5.

7 NLR = Noise Level Reduction; i.e., the attenuation of sound level from outside to inside provided by the structure.

BASIS FOR COMPATIBILITY ZONE BOUNDARIES

The following general guidelines are used in establishing the Compatibility Zone boundaries for each airport depicted in Chapter 3. Modifications to the boundaries may be made to reflect specific local conditions such as existing roads, property lines, and land uses.

A The boundary of this zone for each airport is defined by the runway protection zones (formerly called runway clear zones) and the airfield building restriction lines.

Runway protection zone dimensions and locations are set in accordance with Federal Aviation Administration standards for the proposed future runway location, length, width, and approach type as indicated on an approved Airport Layout Plan. If no such plan exists, the existing runway location, length, width, and approach type are used.

The building restriction line location indicated on an approved Airport Layout Plan is used where such plans exist. For airports not having an approved Airport Layout Plan, the zone boundary is set at the following distance laterally from the runway centerline:

Visual runway for small airplanes	370 feet
Visual runway for large airplanes	500 feet
Nonprecision instrument runway for large airplanes	500 feet
Precision instrument runway	750 feet

These distances allow structures up to approximately 35 feet height to remain below the airspace surfaces defined by Federal Aviation Regulations Part 77.

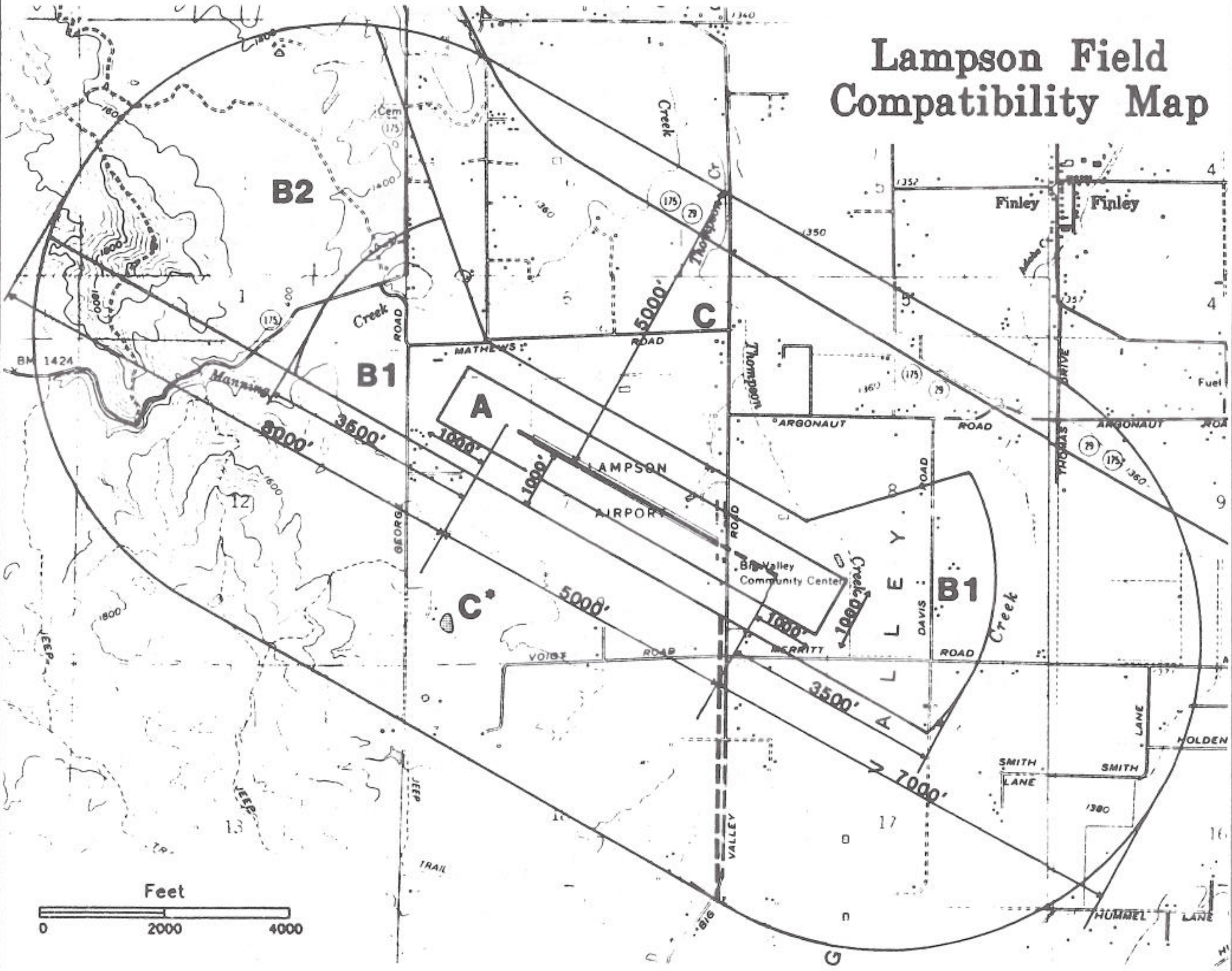
B1 The outer boundary of the Approach/Departure Zone is defined as the area where aircraft are commonly below 400 feet above ground level (AGL). For visual runways, this location encompasses the base leg of the traffic pattern as commonly flown. For instrument runways, the altitudes established by approach procedures are used. Zone B1 also includes areas within 1,000 feet laterally from the runway centerline.

B2 The Extended Approach/Departure Zone includes areas where aircraft are commonly below 800 feet AGL on straight-in approach or straight-out departure. It applies to runways with more than 500 operations per year by large aircraft (over 12,500 pounds maximum gross takeoff weight) and/or runway ends with more than 10,000 total annual takeoffs.

C The outer boundary of the Common Traffic Pattern Zone is defined as the area where aircraft are commonly below 1,000 feet AGL (i.e., the traffic pattern and pattern entry points). This area is considered to extend 5,000 feet laterally from the runway centerline and from 5,000 to 10,000 feet longitudinally from the end of the runway primary surface. The length depends upon the runway classification (visual versus instrument) and the type and volume of aircraft accommodated. For runways having an established traffic solely on one side, the shape of the zone is modified accordingly.

D The outer boundary of the Other Airport Environs Zone conforms with the adopted Planning Area for each airport.

Exhibit C-5A Continued



Source: Lake County Airport Land Use Compatibility Plan (1992)

Exhibit C-5B

Compatibility Map

Lampson Field

AIRPORT NOISE/LAND USE COMPATIBILITY MATRIX
LINDBERGH FIELD

LAND USE	Annual Community Noise Equivalent Level (CNEL) in Decibels: 55	60	65	70	75	80
1. OUTDOOR AMPHITHEATERS						
2. NATURE PRESERVERS, WILDLIFE PRESERVERS, LIVESTOCK FARMING, NEIGHBORHOOD PARKS AND PLAYGROUNDS						
3. SCHOOLS, PRESCHOOLS, LIBRARIES		45	45	45		
4. RESIDENTIAL - SINGLE FAMILY, MULTIPLE FAMILY MOBILE HOMES, RESIDENTIAL HOTELS, RETIREMENT HOMES, INTERMEDIATE CARE FACILITIES, HOSPITALS NURSING HOMES		45	45	45		
5. HOTELS AND MOTELS, OTHER TRANSIENT LODGING, AUDITORIUMS, CONCERT HALLS, INDOOR ARENAS, CHURCHES		45	45	45	45	
6. OFFICE BUILDINGS-BUSINESS, EDUCATIONAL PROFESSIONAL AND PERSONAL SERVICES; R&D OFFICES AND LABORATORIES			50	50	50	
7. RIDING STABLES, WATER RECREATION FACILITIES, REGIONAL PARKS AND ATHLETIC FIELDS, CEMETARIES, OUTDOOR SPECTATOR SPORTS, GOLF COURSES						
8. COMMERCIAL-RETAIL; SHOPPING CENTERS, RESTAURANTS, MOVIE THEATERS			50	50	50	
9. COMMERCIAL-WHOLESALE; INDUSTRIAL; MANUFACTURING						
10. AGRICULTURE (EXCEPT RESIDENCES AND LIVESTOCK), EXTRACTIVE INDUSTRY, FISHING, UTILITIES, & PUBLIC R-O-W						

COMPATIBLE
The outdoor community noise equivalent level is sufficiently attenuated by conventional construction that the indoor noise level is acceptable, and both indoor and outdoor activities associated with the land use may be carried out with essentially no interference from aircraft noise.

45

CONDITIONALLY COMPATIBLE
The outdoor community noise equivalent level will be attenuated to the indoor level shown, and the outdoor noise level is acceptable for associated outdoor activities.

45

INTERIOR ONLY, CONDITIONALLY COMPATIBLE
The community noise equivalent level is severe. Although extensive mitigation techniques make the indoor environment acceptable for performance of activities, the outdoor environment continues to be intolerable for outdoor activities associated with the land use, and must be limited to the extent practicable.

INCOMPATIBLE
The community noise equivalent level is too severe for either interior or outdoor use of the category indicated.

This matrix should be used with reference to the Implementation Directives shown on the reverse.

Exception:
Any residential use is considered compatible if an avigation easement for aircraft noise has been acquired by the airport operator. Other determinations of compatibility are shown on the matrix.

Source: Comprehensive Land Use Plan: Lindbergh Field, San Diego (1991)

Exhibit C-6A

Noise/Land Use Compatibility Matrix
Lindbergh Field

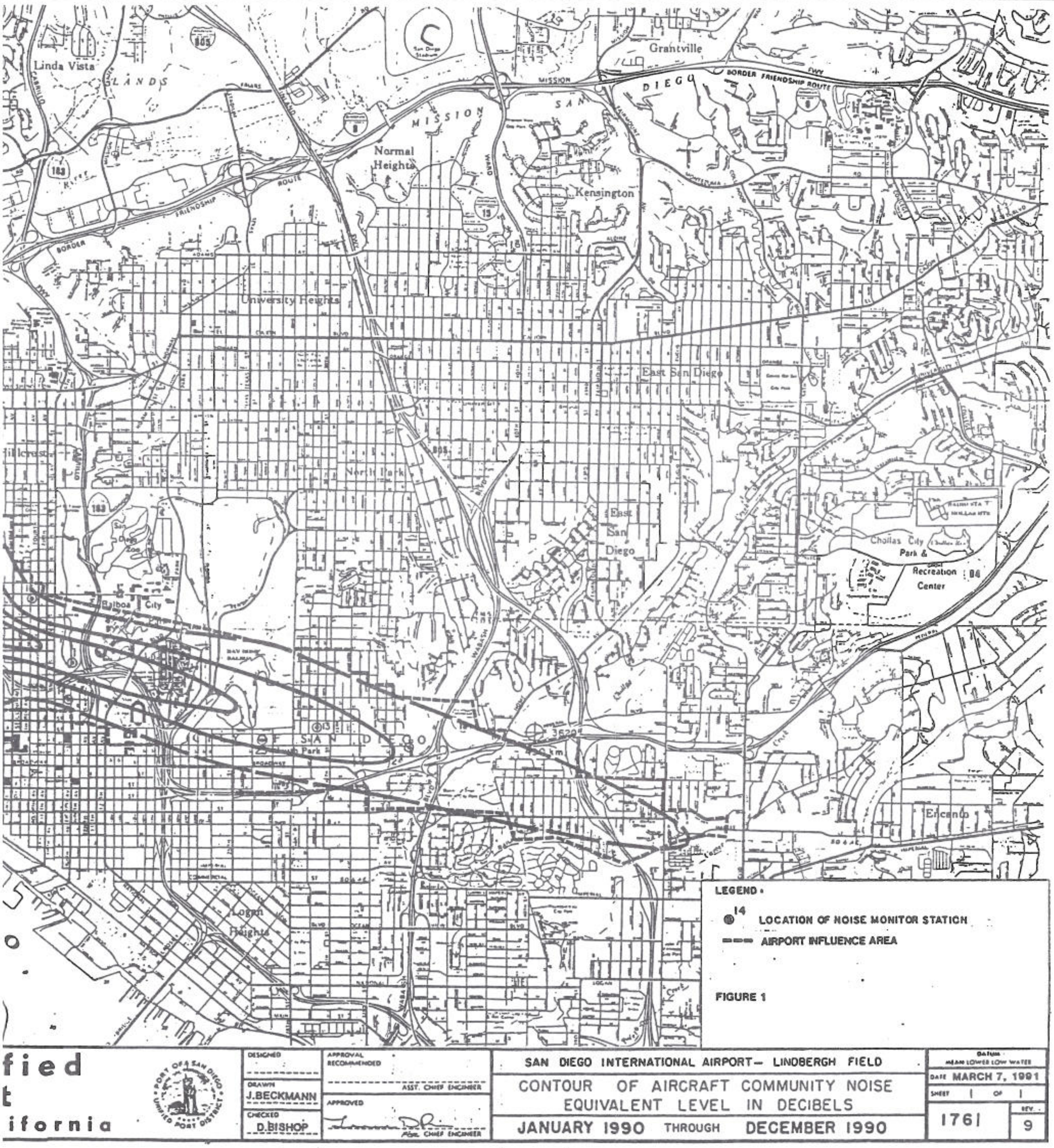


Exhibit C-6B

Community Noise Equivalent Level Contours

Lindbergh Field

Land Use Areas

The various land uses designated in the Airport Land Use Plan are intended to be consistent with the provisions of Title 19, Mono County Zoning and Development Code and are described in the following paragraphs.

Open Area (OA). The open area designation is intended to protect and preserve those lands which provide low-intensity recreational opportunities, visual open space, habitat for wildlife resources, open range for stock grazing, or stream environment zones. Approximately 8,480 acres of open space within the planning area is either currently leased or is available for lease for geothermal exploration and development as shown on Figure 20. General open space development requirements and permitted land uses are defined in Chapter 19.18 of the Zoning Code. Residential land uses are not permitted in the OA district. An additional identifier has been utilized to specify acceptable uses of open area lands (subject to use permit procedures) as follows:

> OA-A: Indicates open space land which is presently utilized for non-intensive agricultural uses. Designation primarily includes Inyo National Forest, Bureau of Land Management (BLM) and City of Los Angeles range lands utilized for stock grazing.
>
> OA-M: Indicates open space land which requires resource management for the protection of visual quality, wildlife habitat, and wilderness value. Designation primarily includes Inyo National Forest and BLM lands under federal jurisdiction.
>
> OA-R: Indicates open space lands which provide specific low-intensity recreational opportunities. Designation reflects existing picnic, day use, hot spring facilities along Hot Creek, and an existing campground adjacent to Convict Creek. The westerly portion of Doe Ridge is designated for future diversified recreational uses including nordic and cross-country ski trails, snowmobiling, equestrian facilities, and potential golf course development.
>
> OA-SC: Designates stream conservation zones along Mammoth Creek/Hot Creek and Convict Creek for the protection of water quality, riparian vegetation, and fishery resources. Conservation zone extends 100 feet on each side of all stream channels. No significant grading alterations, vegetative removals, or building structures are permitted within the stream conservation zone.

Institutional/Public Land (PA). The PA designation is intended to define those public lands which are utilized for regional recreational, natural resource development, institutional, and governmental service purposes. The PA District is described in Chapter 19.19 of the Zoning Code which emphasizes resource development and recreational land uses. The chapter notes that the county may not have permitting authority over lands under state or federal jurisdiction, but indicates the intent of the county to review PA development proposals on the basis of the code.

Industrial (I) and Industrial Park (IP). These land use designations conform with Chapters 19.17 and 19.16 of the County Zoning and Development Code. Virtually all uses within this category are subject to use permit procedures due to the inherent potential for environmental impacts, safety hazards, and nuisances. Lands considered suitable for industrial and manufacturing land uses are limited to three existing sites in the airport planning area: the Sierra Quarry private property, the Forest Service gravel pit, and the Caltrans gravel pit.

Source: Mammoth-June Lake Airport Land Use Plan (1987)

Exhibit C-7A

Land Use Descriptions

Mammoth-June Lake Airport

The old Mammoth Elementary School site is designated for industrial park (IP) land uses in consideration of its inherent economic development potential. Only non-polluting light industrial uses are permitted within this zone, and all proposed development should be carefully controlled.

Planned Unit Development (PUD). Only one site within the planning area is designated for Planned Unit Development land uses: the 130-acre Hot Creek Ranch property. The site straddles the Hot Creek stream conservation zone and is environmentally sensitive. The use of the PUD designation as defined in Chapter 19.20 of the Zoning Code allows mixed recreational/resort land uses subject to natural resource protection requirements and environmental constraints. Maximum overall development density for the property is equivalent to one residential unit per acre. The intent of the PUD zoning designation is to require the approval of an overall master plan for the property prior to any additional development. Criteria applicable to such development includes the preservation of open space areas, conservation of sensitive riparian and stream zones, and clustering of proposed resort residential uses to minimize environmental disturbances and impacts.

Airport Development District (ADD). The intent of the ADD designation is to permit the development of appropriate resort, commercial, light industrial, and aviation support uses on lands adjacent to the Mammoth/June Lake Airport. The present Zoning Code does not define a land use district that adequately addresses the combination of commercial and light industrial uses which are anticipated within the airport development district. Accordingly, the Airport Land Use Plan proposes that Title 19, Zoning and Development Code, be amended to include Chapter 19.47 which defines an Airport Development Zone and establishes the requirements and provisions applicable to the district. The proposed text of Chapter 19.47 is presented in Appendix A.

The Airport Development District has been specifically created to recognize the economic development potential associated with the expansion of services and facilities at the airport site. Although light industrial, manufacturing, and warehousing developments are necessary for economic stability and growth, these land uses are frequently incompatible with residential, agricultural, and open space land uses. This inherent incompatibility has limited the land resources available for economic development within the county. Subject to the constraints associated with the proximity of aircraft activities, the following land uses are proposed for the Airport Development District:

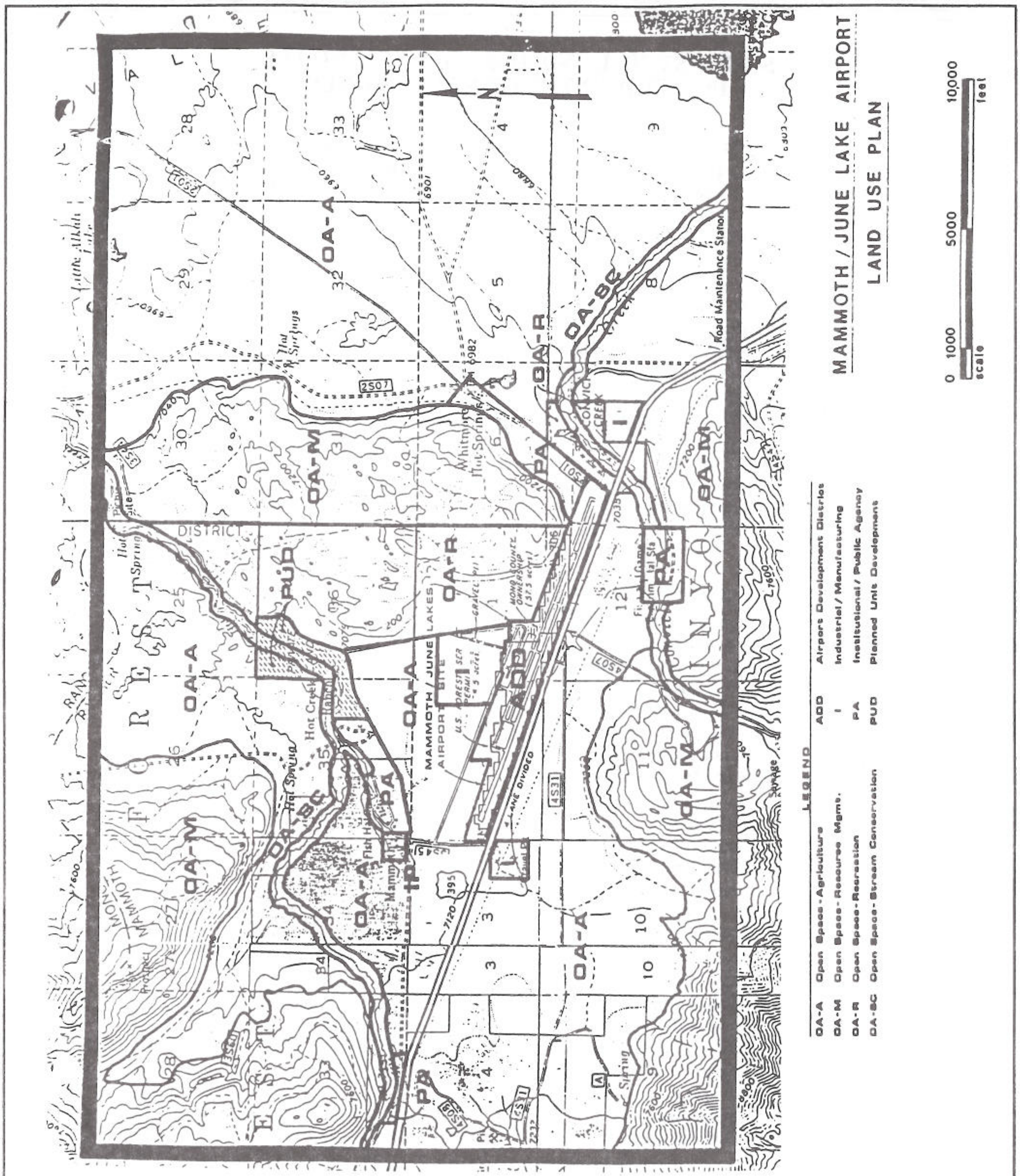
1. Airport operational facilities.
2. Aviation products and services.
3. Hotel/motel and lodging developments.
4. Limited light industrial and warehousing.
5. Office, business and commercial.
6. Public buildings.
7. Retail sales and services ancillary to airport terminal or hotel/motel facilities.
8. Automobile fueling facilities in conjunction with other land use/development.

All of the permitted land uses within the Airport Development District are subject to review and approval of the Airport Land Use Commission.

Proposed Airport Development and Expansion

The expansion and improvement programs outlined in the 1978 Mammoth/June Lake Airport Master Plan are only partially completed at the present time. A schematic layout of existing airport facilities is presented in Figure 7. As noted previously, proposed Master Plan improvements include expansions and development of the existing terminal area as well as infrastructure systems. In addition, a proposal has been submitted for the development of a major hotel within the core area of the terminal complex.

Exhibit C-7A Continued



Source: Mammoth-June Lake Airport Land Use Plan (1987)

Exhibit C-7B

Land Use Plan

Mammoth-June Lake Airport

SUGGESTED LAND USE COMPATIBILITY IN ACCIDENT POTENTIAL ZONES

SLUCM No.	Land Use Name	CLEAR ZONE	Accident Potential Zones APZ I	APZ II
10	**RESIDENTIAL**			
11	Household Units			
11.11	Singel units; detached	N	N	Y (1)
11.12	Single units; semidetached	N	N	N
11.13	Single units; attached row	N	N	N
11.21	two units; side-by-side	N	N	N
11.22	Two units; one above the other	N	N	N
11.31	Apartments; walk up	N	N	N
11.32	Apartments; elevator	N	N	N
12	Group quarters	N	N	N
13	Residential hotels	N	N	N
14	Mobile home parks or courts	N	N	N
15	Transient lodgings	N	N	N
16	Other residential	N	N	N (1)
20	**MANUFACTURING**			
21	Food and kindred products	N	N (2)	Y
22	Textile mill products	N	N (2)	Y
23	Apparel and other finished products made from fabrics, leather, and similar materials	N	N	N (2)
24	Lumber and wood products	N	Y (2)	Y
25	Furniture and fixtures	N	Y (2)	Y
26	Paper and allied products	N	Y (2)	Y
27	Printing, publishing, and allied industries	N	Y (2)	Y
28	Chemicals and allied products	N	N	N (2)
29	Petroleum refining and related industries	N	N	N
31	Rubber and plastic products	N	N (2)	N (2)
32	Stone, clay, and glass products	N	N (2)	Y
33	Primary metal industries	N	N (2)	Y
34	Fabricated metal products	N	N (2)	Y
35	Professional, scientific, and controlling instruments; photographic and optical goods; watches and clocks manufacturing	N	N	N (2)
39	Miscellaneous manufacturing	N	Y (2)	Y (2)

Source: Naval Air Facility El Centro Air Installation Compatible Use Zones (1990)

Exhibit C-8A

Suggested Land Use Compatibility in Accident Potential Zones

Naval Air Facility El Centro

SLUCM No.	Land Use Name	Accident Potential Zones CLEAR ZONE	APZ I	APZ II
40	TRANSPORTATION, COMMUNICATION, AND UTILITIES			
41	Railroad, rapid rail transit and street railway transportation	N (3)	Y (4)	Y
42	Motor vehicle transportation	N (3)	Y	Y
43	Aircraft transportation	N (3)	Y (4)	Y
44	Marine craft transportation	N (3)	Y (4)	Y
45	Highway & street right-of-way	N (3)	Y	Y
46	Automobile parking	N (3)	Y (4)	Y
47	Communication	N (3)	Y (4)	Y
48	Utilities	N (3)	Y (4)	Y
49	Other transportation, communication, and utilities	N (3)	Y (4)	Y
50	TRADE			
51	Wholesale trade	N	Y (2)	Y
52	Retail trade - building materials, hardware and farm equipment	N	Y (2)	Y
53	Retail trade - general merchandise	N	N (2)	Y (2)
54	Retail trade - food	N	N (2)	Y (2)
55	Retail trade - automotive, marine craft, aircraft, and acessories	N	Y (2)	Y
56	Retail trade - apparel and accessories	N	N (2)	Y (2)
57	Retail trade - furniture, home furnishings, and equipment	N	N (2)	Y (2)
58	Retail trade - eating and drinking esablishments	N	N	N (2)
59	Other retail trade	N	N (2)	Y (2)

Exhibit C-8A Continued

SLUCM No.	Land Use Name	Accident Potential Zones CLEAR ZONE	APZ I	APZ II
60	**SERVICES**			
61	Finance, insurance, and real estate services	N	N	Y (6)
62	Personal services	N	N	Y (6)
62.4	cemeteries	N	Y (7)	Y (7)
63	Business services	N	Y (8)	Y (8)
64	Repair services	N	Y (2)	Y
65	Professional services	N	N	Y (6)
65.1	Hospitals and nursing homes	N	N	N
65.1	Other medical facilities	N	N	N
66	Contract construction services	N	Y (6)	Y
67	Governmental services	N	N	Y (6)
68	Educational services	N	N	N
69	Miscellaneous services	N	N2	Y (2)
70	**CULTURAL, ENTERTAINMENT, AND RECREATIONAL**			
71	Cultural activities (including churches)	N	N	N (2)
71.2	Nature exhibits	N	Y (2)	Y
72	Public assembly	N	N	N
72.1	Auditoriums and concert halls	N	N	N
72.11	Outdoor music shells and amphitheaters	N	N	N
72.2	Outdoor sports arenas and spectator sports	N	N	N
73	Amusements	N	N	Y (8)
74	recreational activities (incl. golf courses, riding stables, water recreation)	N	Y (8,9,10)	Y
75	Resorts and group camps	N	N	N
76	Parks	N	Y (8)	Y (8)
79	Other culture, entertainment, and recreation	N	Y (9)	Y (9)
80	**RESOURCE PRODUCTION AND EXTRACTION**			
81	Agriculture (except livestock)	Y	Y	Y
81.5 81.7	Livestock farming and animal breeding	N	Y	Y
82	Agricultural related activities	N	Y (5)	Y
83	Forestry activities and related services	N (5)	Y	Y
84	Fishing activities & related serv.	N (5)	Y (5)	Y
85	Mining activities & related serv.	N	Y (5)	Y
89	Other resource production and extraction	N	Y (5)	Y

Exhibit C-8A Continued

NOTES FOR SUGGESTED LAND USE COMPATIBILITY IN ACCIDENT POTENTIAL ZONES

1. Suggested maximum density 1-2 dwelling units per acre, possibly increased under a Planned Unit Development (PUD) where maximum lot coverage is less than 20 percent

2. Within each land use category, uses exist where further evaluation may be needed due to the variation of densities of people and structures. For example, where a small neighborhood retail store may be compatible with APZ-II, a shopping center or strip shopping mall would be incompatible due to the density of development and concentration of people.

3. The placing of structures, buildings, or above-ground utility lines in the clear zone is subject to severe restrictions. In a majority of the clear zones, these items are prohibited. See NAVFAC P-80.3 (NOTAL) for specific guidance.

4. No passenger terminals and no major above-ground transmission lines in APZ-I.

5. Factors to be considered: labor intensity, structural coverage, explosive characteristics, air pollution.

6. Low-intensity office uses only. Meeting places, auditoriums, etc., not recommended.

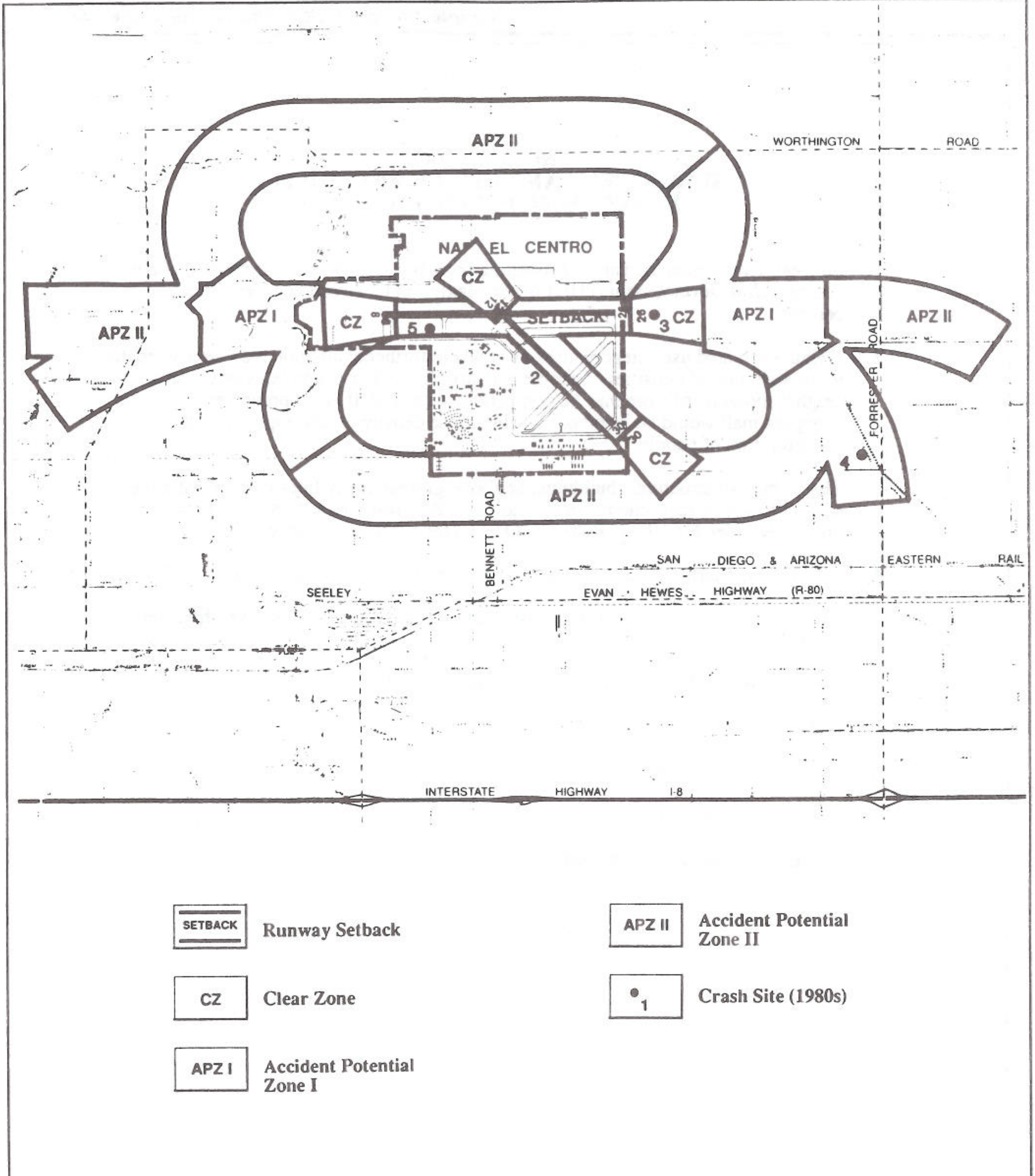
7. Excludes chapels.

8. Facilities must be low-intensity.

9. Clubhouse not recommended.

10. Large classes not recommended.

Exhibit C-8A Continued

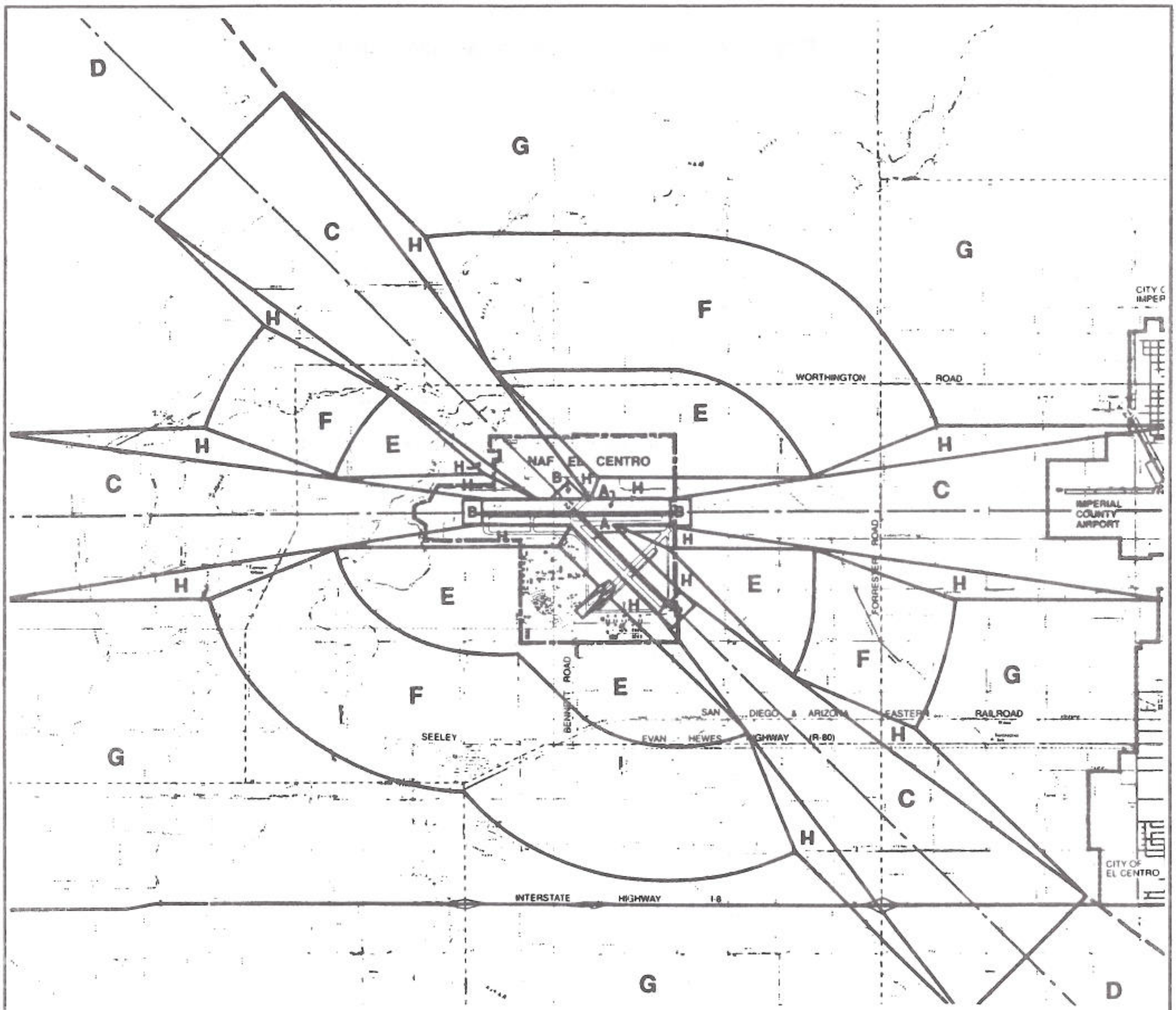


Source: Naval Air Facility El Centro Air Installation Compatible Use Zones (1990)

Exhibit C-8B

Accident Potential Zones

Naval Air Facility El Centro



A	Primary Surface	E	Inner Horizontal Surface (150 Feet Above Airfield Elevation)
B	Clear Zone Surface	F	Conical Surface (20:1)
C	Approach-Departure Clearance Surface (Glide Angle = 50:1)	G	Outer Horizontal Surface (500 Feet Above Airfield Elevation)
D	Approach-Departure Clearance Surface (Horizontal)	H	Transitional Surface (7:1)

Source: Naval Air Facility El Centro Air Installation Compatible Use Zones (1990)

Exhibit C-8C

Airspace Plan

Naval Air Facility El Centro

City of Vacaville Zoning Implementation Standards

A ZONE

(Density Standard 10 persons/acre in buildings. 15 persons/acre outside buildings)

ACCEPTABLE USES

- Pastures and open space
- Parks with very low intensity uses
- Aircraft tiedowns
- Auto parking
- Nurseries
- Outside storage
- Any other uses which are conclusively determined by the Planning Director to have an anticipated density of less than 10 persons per acre in buildings and less than 15 persons per acre outside of buildings on the basis of specific floor plans and other related information.
- Any other uses which are determined by the Planning Director and the Airport Land Use Commission to generally not have an anticipated maximum density of more than 10 persons per acre in buildings, and not more than 15 persons per acre outside of buildings on the basis of specific floor plans and other related information.

NORMALLY NOT ACCEPTABLE USES

- Warehouses
- ML Zoning District uses
- MH Zoning District uses

PROHIBITED USES

- Any substantial assemblage of people
- Any structure that exceeds the height limits established herein
- Any noise sensitive uses
- Any residential uses

B ZONE

(Density Standard 20 persons/acre in buildings. 40 persons/acre outside buildings).

ACCEPTABLE USES

- Acceptable Uses from the A Zone
- Parks with low intensity uses
- Nurseries
- Warehouses
- Manufacturing uses permitted in the ML Zoning District
- Manufacturing uses permitted in the MH Zoning District
- Any other uses which are conclusively determined by the Planning Director to have an anticipated density of less than 20 persons per acre in buildings and less than 40 persons per acre outside of buildings on the basis of specific floor plans and other related information.
- Any other uses which are determined by the Planning Director and the Airport Land Use Commission to generally not have an anticipated maximum density of more than 20 persons per acre in buildings, and not more than 40 persons per acre outside of buildings on the basis of specific floor plans and other related information.

NORMALLY NOT ACCEPTABLE USES

- Retail uses
- Office uses (except as accessory to Acceptable Uses)
- Hotels and motels

PROHIBITED USES

- Any substantial assembly of people
- Any structure that exceeds the height limits established herein

Source: Solano County Airport Land Use Compatibility Plan (1988)

Exhibit C-9A

Density Standards Implementation

Nut Tree Airport (City of Vacaville)

C ZONE

(Density Standards 40 persons/acre in buildings. 75 persons/acre outside buildings)

ACCEPTABLE USES

- Acceptable Uses from the B Zone
- Retail uses (one story maximum, except storage)
- Office ad financial uses (one story maximum, except storage)
- Auto dealerships
- Motels (one story maximum)
- Any other uses which are conclusively determined by the Planning Director to have an anticipated density of less than 50 persons per acre in buildings and less than 75 persons per acre outside of buildings on the basis of specific floor plans and other related information.

- Any other uses which are determined by the Planning Director and the Airport Land Use Commission to generally not have an anticipated maximum density of more than 50 persons per acre in buildings, and not more than 75 persons per acre outside of buildings on the basis of specific floor plans and other related information.

NORMALLY NOT ACCEPTABLE USES

- Multiple story retail, office and financial uses
- Theaters, auditoriums, assembly halls and churches
- Amusement and indoor recreation uses
- Restaurants and bars

PROHIBITED USES

- Schools, libraries, hospitals and nursing homes
- Noise sensitive outdoor uses
- New residential uses

D ZONE

(Density Standard 100 persons/acre in buildings. 150 persons/ acre outside buildings.)

ACCEPTABLE USES

- Acceptable Uses from the C Zone
- Restaurants and bars (one story maximum, except storage)
- Office and financial uses (two story maximum)
- Retail uses (two story maximum)
- Motels (two story maximum)
- Any other uses which are conclusively determined by the Planning Director to have an anticipated density of less than 100 persons per acre in buildings and less than 150 persons per outside of buildings on the basis of specific floor plans and other related information.
- Any other uses which are determined by the Planning Director and the Airport Land Use Commission to generally not have an anticipated maximum density of more than 100 persons per acre in buildings, and not more than 150 persons per acre outside of buildings on the basis of specific floor plans and other related information.

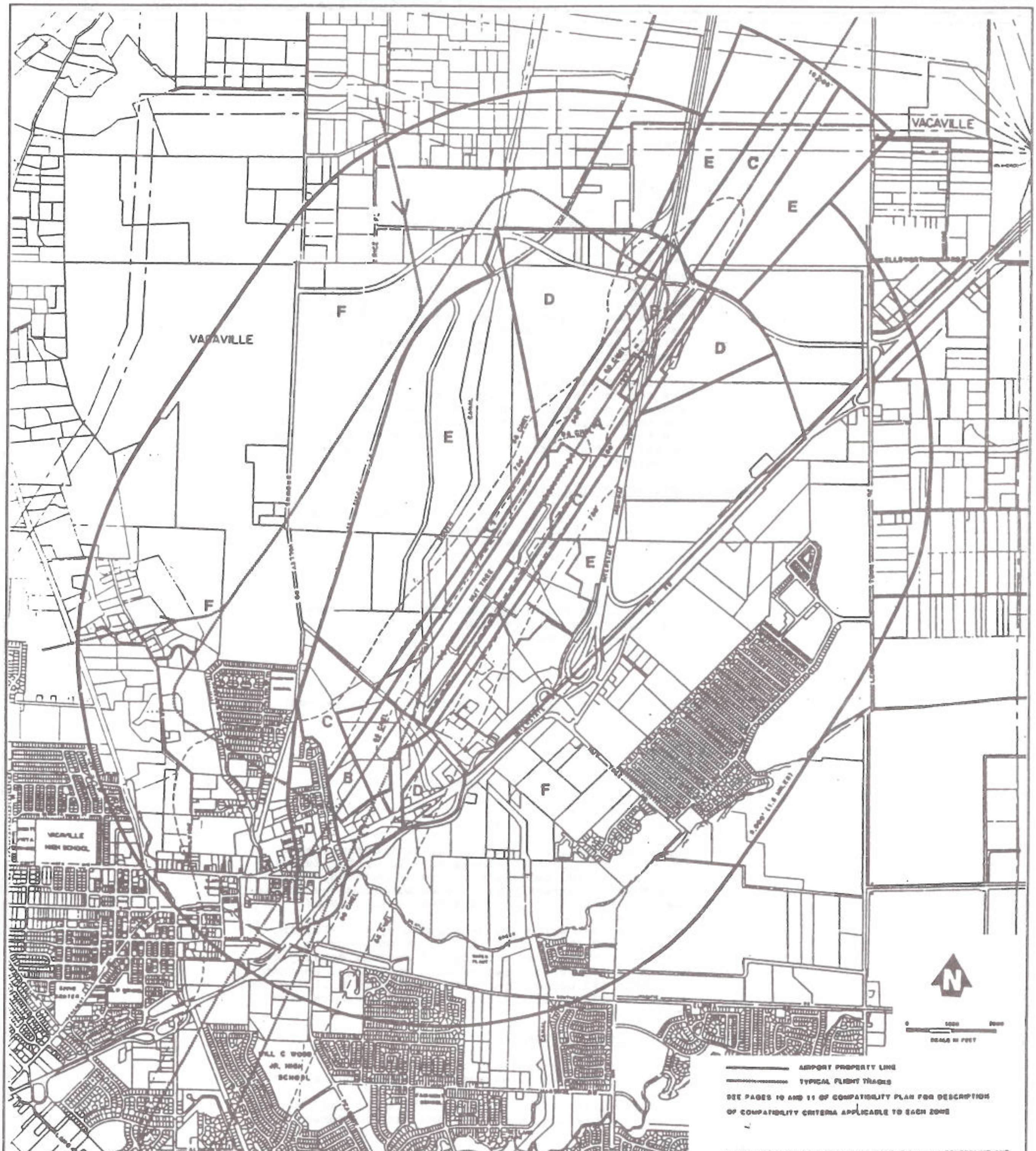
NORMALLY NOT ACCEPTABLE USES

- New single family residential uses
- Large shopping Malls (exceeding 500,000 square feet in area)
- Theaters, auditoriums, assembly halls and churches
- Schools, libraries, hospitals and nursing homes

PROHIBITED USES

- Noise sensitive outdoor uses

Exhibit C-9A Continued



Source: Solano County Airport Land Use Compatibility Plan (1988)

Exhibit C-9B

Compatibility Map

Nut Tree Airport

LAND USE	COMMUNITY NOISE EQUIVALENT LEVEL (CNEL) IN DECIBELS				
RESIDENTIAL	60-65	65-70	70-75	75-80	80+
RESIDENTIAL, OTHER THAN MOBILE HOMES AND TRANSIENT LODGINGS	N[4]	N[4]	N[4]	N	N
MOBILE HOME PARKS	N	N	N	N	N
TRANSIENT LODGINGS	Y	Y[1]	N	N	N
PUBLIC/INSTITUTIONAL					
SCHOOLS	Y	N	N	N	N
HOSPITALS AND NURSING HOMES	Y	N	N	N	N
CHURCHES, AUDITORIUMS, AND CONCERT HALLS	Y	N	N	N	N
GOVERNMENTAL SERVICES	Y	Y	Y[2]	Y[3]	N
TRANSPORTATION	Y	Y	Y[2]	Y[3]	N
PARKING	Y	Y	Y[2]	Y[3]	N
COMMERCIAL USE					
OFFICES, BUSINESS AND PROFESSIONAL	Y	Y	Y[2]	Y[3]	N
WHOLESALE AND RETAIL—BUILDING MATERIALS, HARDWARE AND FARM EQUIPMENT	Y	Y	Y[2]	Y[3]	N
RETAIL TRADE—GENERAL	Y	Y	Y[2]	Y[3]	N
UTILITIES	Y	Y	Y[2]	Y[3]	N
COMMUNICATION	Y	Y	Y[2]	Y[3]	N
INDUSTRIAL					
MANUFACTURING	Y	Y	Y	Y[3]	N
MINING, FISHING, RESOURCE EXTRACTION	Y	Y	Y	Y	Y
RECREATION/OPEN SPACE/AGRICULTURE					
OUTDOOR SPORTS ARENAS	Y	Y	Y	N	N
OUTDOOR MUSIC SHELLS, AMPHITHEATERS	Y	N	N	N	N
WILDLIFE EXHIBITS AND ZOOS	Y	Y	N	N	N
PARKS, RESORTS, AND CAMPS	Y	Y	Y	N	N
GOLF COURSES, RIDING STABLES, AND WATER RECREATION	Y	Y	Y	N	N
LIVESTOCK, FARMING AND BREEDING	Y	Y	Y	N	N
CROP RAISING	Y	Y	Y	Y	Y

SEE OTHER SIDE FOR KEY TO TABLE

Source: *Riverside Municipal Airport Comprehensive Land Use Plan (1993)*

Exhibit C-10A

Land Use Standards for Noise Compatibility

Riverside Municipal Airport

KEY TO TABLE 11

Y (Yes)	Land use and related structures compatible and permitted (subject to other local land use controls).
N (No)	Land use and related structures not compatible and not permitted within designated CNEL range.
Y[1]	Land use and related structures generally compatible provided that measures to achieve an outdoor to indoor noise level reduction (NLR) of 25 dB are incorporated into design and construction of sleeping rooms.
Y[2]	Land use and related structures generally compatible provided that measures to achieve an outdoor to indoor noise level reduction (NLR) of 30 dB are incorporated into design and construction of office areas and public reception and gathering areas within buildings.
Y[3]	Land use and related structures generally compatible provided that measures to achieve an outdoor to indoor noise level reduction (NLR) of 35 dB are incorporated into design and construction of office areas and public reception and gathering areas within buildings.
N[4]	Residences for caretakers or security personnel may be permitted as accessory uses to commercial or industrial uses. Measures to achieve the required outdoor to indoor noise level reduction (NLR) shall be incorporated into the design of the residences as follows: in the 60-70 dB CNEL range — 25 dB NLR in the 70-75 dB CNEL range — 30 dB NLR

Exhibit C-10A Continued

Table 12
LAND USE COMPATIBILITY GUIDELINES FOR AIRPORT SAFETY ZONES FOR RIVERSIDE MUNICIPAL AIRPORT[1, 2]

Safety Zone	Maximum Population Density	Maximum Coverage By Structures	Land Use
ETZ — Emergency Touchdown Zone	0[3]	0[3]	No significant obstructions[4]
ISZ — Inner Safety Zone	0[3]	0[3]	No petroleum or explosives No above-grade powerlines
OSZ — Outer Safety Zone	Uses in structures:[5] 25 persons/ac. OR 150 persons/bldg. (see text for explanation) Uses not in structures: 50 persons/ac.	25% of net area	No residential No hotels, motels No restaurants, bars No schools, hospitals, government services No concert halls, auditoriums No stadiums, arenas No public utility stations, plants No public communications facilities No uses involving, as the primary activity, manufacture, storage, or distribution of explosives or flammable materials
ERC — Extended Runway Centerline Zone	3 du/net acre Uses in structures[5]: 75 persons/ac. or 300 persons/bldg. (see text for explanation)	50% of gross area or 65% of net area, whichever is greater	No uses involving, as the primary activity, manufacture, storage, or distribution of explosives or flammable materials.[6]
TPZ — Traffic Pattern Zone	Not Applicable	50% of gross area or 65% of net area, whichever is greater	Discourage schools, auditoriums, amphitheaters, stadiums Discourage uses involving, as the primary activity, manufacture, storage, or distribution of explosives or flammable materials.[6]

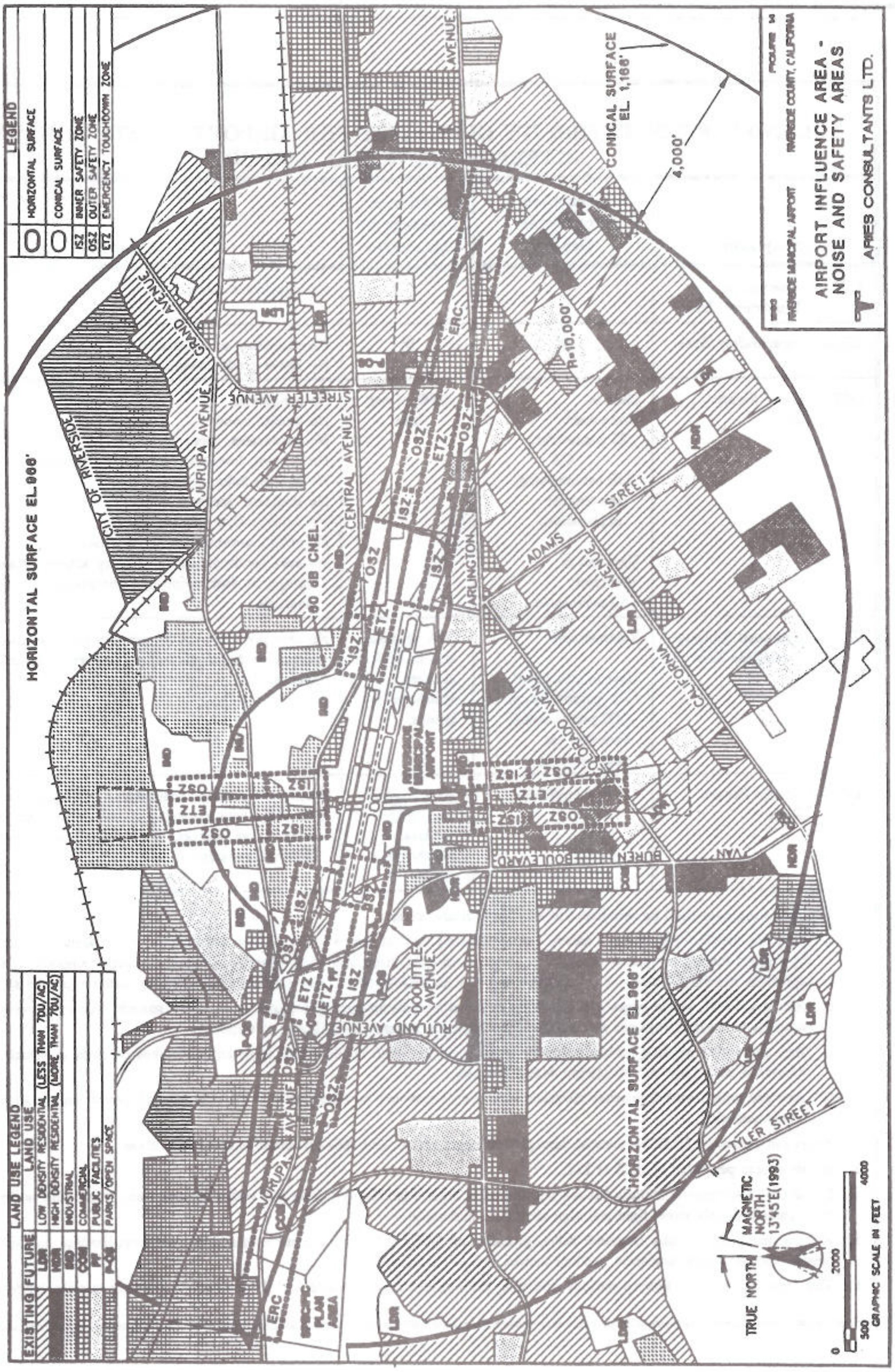
1. The following uses shall be prohibited in all airport safety zones:
   a. Any use which would direct a steady light or flashing light of red, white, green, or amber colors associated with airport operations toward an aircraft engaged in an initial straight climb following takeoff or toward an aircraft engaged in a straight final approach toward a landing at an airport, other than an FAA-approved navigational signal light or visual approach slope indicator.
   b. Any use which would cause sunlight to be reflected towards an aircraft engaged in an initial straight climb following takeoff or towards an aircraft engaged in a straight final approach towards a landing at an airport.
   c. Any use which would generate smoke or water vapor or which would attract large concentrations of birds, or which may otherwise affect safe air navigation within the area.
   d. Any use which would generate electrical interference that may be detrimental to the operation of aircraft and/or aircraft instrumentation.
2. Avigation easements shall be secured through dedication for all land uses permitted in any safety zones.
3. No structures permitted in ETZ or ISZ.
4. Significant obstructions include but are not limited to large trees, heavy fences and walls, tall and steep berms and retaining walls, non-frangible street light and sign standards, billboards.
5. A "structure includes fully enclosed buildings and other facilities involving fixed seating and enclosures limiting the mobility of people, such as sports stadiums, outdoor arenas, and amphitheaters.
6. This does not apply to service stations involving retail sale of motor vehicle fuel if fuel storage tanks are installed underground.

Source: Riverside Municipal Airport Comprehensive Land Use Plan (1993)

Exhibit C-10B

Land Use Compatibility Guidelines for Airport Safety Zones

Riverside Municipal Airport



*Source: **Riverside Municipal** Airport Comprehensive Land Use Plan (1993)*

Exhibit C-10C

Airport Influence Area: Noise and Safety Areas

Riverside Municipal Airport

SACRAMENTO METROPOLITAN AIRPORT LAND USE COMPATIBILITY GUIDELINES FOR SAFETY			
LAND USE CATEGORY and (Standard Industrial Classification Code)	COMPATIBILITY WITH		
	CLEAR ZONE	APPROACH-DEPARTURE ZONE	OVERFLIGHT ZONE
RESIDENTIAL			
Single-family detached	No	Yes[1]	Yes[13]
Two-family dwelling	No	No	Yes[13]
Multi-family dwelling (3+ families)	No	No	Yes[13]
Group quarters & rooming houses (702, 704)	No	No	Yes[13]
Mobile home parks or courts (6515)	No	No	Yes[13]
MANUFACTURING			
Food & kindred products (20)	No	No	Yes[13]
Textiles & apparel (22, 23)	No	No	Yes[13]
Transportation equipment (37)	No	No	Yes[13]
Lumber & wood products (24)	No	No	Yes[13]
Furniture & fixtures (25)	No	No	Yes[13]
Paper & allied products (26)	No	No	Yes[13]
Printing & publishing (27)	No	No	Yes[13]
Chemicals & allied products (28)	No	No	No
Asphalt Paving & Misc. Petroleum (295, 299)	No	No	Yes[13]
Petroleum refining (2911)	No	No	No
Rubber & plastics (30)	No	No	No
Stone, clay, glass & concrete products (32)	No	No	Yes
Primary & fabricated metals (33, 34)	No	No	Yes[13]
Electrical, and electronic equipment (36)	No	No	Yes[13,14]
Leather products (31)	No	No	Yes[13]
Industrial, commercial & computer equipment (35)	No	No	Yes[13,14]
Photo, optical & medical equipment (38)	No	No	Yes[13]
Miscellaneous manufacturing (39)	No	No	Yes[13]
TRANSPORTATION, COMMUNICATIONS & UTILITIES			
Streets, roads, & highways	No	Yes	Yes
Heavy rail lines: freight & passenger (40)	No	Yes	Yes
Light rail lines: passenger (41)	No	Yes	Yes
Trucking & rail freight terminals (42)	No	No	Yes[13]
Warehousing & storage (422) [4]	No	No	Yes[13]
Passenger terminals & stations	No	No	No
Water transportation: freight & passenger (44)	No	No	Yes[13]
Parking lots (752)	No	Yes[2]	Yes[13]
Transportation services (47)	No	No	Yes[13]
Radio, TV & telephone (48)	No	No	Yes[13,14]
Courier service (4215)	No	No	Yes[13]
Electrical & natural gas generation & switching (491, 492)	No	No	Yes[13,14]
Natural gas & petroleum pipelines & storage (46)	No	No	Yes[13]
Water treatment plants (494)	No	No	Yes[6,13]
Sewer treatment plants (4952)	No	No	Yes[6,13]
Sanitary landfills (4953)	No	No	Yes[6,13]
Recycling & transfer facilities (4953) [7]	No	No	Yes[6,13]
Hazardous material facilities (4953)	No	No	Yes[6,13]

Source: Sacramento Metropolitan Airport Comprehensive Land Use Plan (1993)

Exhibit C-11A

Land Use Compatibility Guidelines for Safety

Sacramento Metropolitan Airport

SACRAMENTO METROPOLITAN AIRPORT LAND USE COMPATIBILITY GUIDELINES FOR SAFETY			
LAND USE CATEGORY and (Standard Industrial Classification Code)	**COMPATIBILITY WITH**		
	CLEAR ZONE	**APPROACH-DEPARTURE ZONE**	**OVERFLIGHT ZONE**
WHOLESALE TRADE			
Paints, varnishes & supplies (5198)	No	No	Yes[13]
Chemicals & allied products	No	No	Yes[13]
Petroleum truck terminals	No	No	Yes[13]
Miscellaneous wholesale trade	No	No	Yes[13]
RETAIL TRADE			
Department & variety stores (single) (53)	No	No	Yes[13]
Lumber, building materials & nurseries (521, 526)	No	No	Yes[13]
Grocery stores & drug stores (54)	No	No	Yes[13]
Paint, glass, wallpaper & hardware (523, 525)	No	No	Yes[13]
Auto, truck, boat & RV dealers (55)	No	No	Yes[13]
Mobile home dealers (527)	No	No	Yes[13]
Auto & truck service stations (554)	No	No	Yes[13]
Fuel dealers (598)	No	No	Yes[13]
Apparel & shoes (56)	No	No	Yes[13]
Home furnishings (57)	No	No	Yes[13]
Eating & drinking (58)	No	No	Yes[13]
Miscellaneous retail trade (59)	No	No	Yes[13]
BUSINESS & PERSONAL SERVICES			
Auto, truck, boat, RV & miscellaneous repair (75, 76)	No	No	Yes[13]
Mobile home repair (1521)	No	No	Yes[13]
Commercial laundries & cleaning (721)	No	No	Yes[13]
Coin-operated laundries (7215)	No	No	Yes[13]
Photographers, beauty & barber, shoe repair (722-725)	No	No	Yes[13]
Funeral services (726)	No	No	Yes[13]
Business services (73)	No	No	Yes[13]
Computer programming & data processing (737)	No	No	Yes[13]
Travel Agencies (4724)	No	No	Yes[13]
Legal & engineering (81, 87)	No	No	Yes[13]
Banks, credit unions & financial (63, 64, 65)	No	No	Yes[13]
Hotels, motels, inns, bed & breakfast (701)	No	No	Yes[13]
Business parks & industrial clusters	No	No	Yes[13]
Office buildings (offices for rent or lease)	No	No	Yes[13]
Business & vocational schools (824, 829)	No	No	Yes[13]
Construction businesses (15, 16, 17)	No	No	Yes[13]
Miscellaneous personal services (729)	No	No	Yes[13]
SHOPPING DISTRICTS			
Neighborhood shopping centers	No	No	Yes[13]
Community shopping centers	No	No	Yes[13]
Regional shopping centers	No	No	No

Exhibit C-11A Continued

SACRAMENTO METROPOLITAN AIRPORT

LAND USE COMPATIBILITY GUIDELINES FOR SAFETY

LAND USE CATEGORY and (Standard Industrial Classification Code)	COMPATIBILITY WITH		
	CLEAR ZONE	APPROACH-DEPARTURE ZONE	OVERFLIGHT ZONE
<u>PUBLIC AND QUASI-PUBLIC SERVICES</u>			
Post offices (53)	No	No	Yes[13]
Government offices (91-96)	No	No	Yes[13]
Government social services (83)	No	No	Yes[13]
Elementary & secondary schools (821)	No	No	No
Colleges & universities (822)	No	No	No
Hospitals (806)	No	No	No
Medical & dental laboratories (807)	No	No	Yes[13]
Doctor & dentist offices (801-804)	No	No	Yes[13]
Museums & art galleries (84)	No	No	Yes[13]
Libraries (823)	No	No	Yes[13]
Churches (866)	No	No	Yes[13]
Cemeteries (6553)	No	Yes[2,10]	Yes[13]
Jails & detention centers (9223)	No	No	No
Child care programs (6 or more children) (835)	No	No	Yes[13]
Nursing care facilities (805)	No	No	Yes[13]
<u>RECREATION</u>			
Neighborhood parks	No	No	Yes[12,13]
Community-wide & regional parks	No	No	No
Riding stables (7999)	No	No	Yes[13]
Golf courses (7992)	No	Yes[2,11]	Yes[11,13]
Open space & natural areas	Yes[3,6]	Yes[2,6,12]	Yes[6,12,13]
Natural water areas	Yes[3,6]	Yes[2,6,12]	Yes[6,12,13]
Recreation & amusement centers (793, 799)	No	No	Yes[13]
Physical fitness & gyms (7991)	No	No	Yes[13]
Camps, campgrounds & RV parks (703)	No	No	No
Dance halls, studios & schools (791)	No	No	Yes[13]
Theaters - live performance (7922)	No	No	No
Motion picture theater - single or double (783)	No	No	No
Motion picture theater complex - 3 or more (783)	No	No	No
Professional sports (7941)	No	No	No
Stadiums and arenas	No	No	No
Auditoriums, concert halls, amphitheaters	No	No	No
Fairgrounds and expositions (7999)	No	No	No
Racetracks (7948)	No	No	No
Theme parks	No	No	No

Exhibit C-11A Continued

SACRAMENTO METROPOLITAN AIRPORT LAND USE COMPATIBILITY GUIDELINES FOR SAFETY			
LAND USE CATEGORY AND (Standard Industrial Classification Code)	**COMPATIBILITY WITH**		
	CLEAR ZONE	**APPROACH-DEPARTURE ZONE**	**OVERFLIGHT ZONE**
<u>AGRICULTURE AND MINING</u>			
Row & field crops (011, 013, 016)	Yes[3,6]	Yes[2,6]	Yes[6,13]
Tree crops (012)	No	Yes[2,6]	Yes[6,13]
Intensive livestock (021, 024, 027)	No	Yes[2,6]	Yes[6,13]
Nursery products (018)	No	Yes[2,6]	Yes[6,13]
Poultry (025)	No	Yes[2,6]	Yes[6,13]
Pasture & grazing	Yes[3,6]	Yes[2,6]	Yes[6,13]
Agricultural services (7)	No	Yes[2]	Yes[13]
Mining & quarrying (10, 12, 14)	No	Yes[2,6]	Yes[6,13]
Oil & gas extraction (13)	No	No	Yes[13]

<u>FOOTNOTES</u>:

1 Use compatible only if directly related to agricultural use of the property for the provision of dwelling units for the land owner's immediate family, or for employees required for the protection of the property. All such dwellings shall be encouraged to locate outside of the Approach-Departure Zone if parcel lines permit.

2 Use compatible only if it does not result in a concentration of persons greater than 25 persons per acre at any time or the storage of flammable or explosive material above ground.

3 No building, structures, above-ground transmission lines, or storage of flammable or explosive material above ground, and no uses resulting in a gathering of more than 10 persons per acre at any time.

4 No bulk petroleum products or chemical storage.

5 Tour operator passenger facilities not allowed.

6 Uses compatible only if they do not result in a possibility that a water area may cause ground fog or result in a bird hazard.

7 Household hazardous waste facilities operated as part of an integrated waste management program and resulting in only temporary storage of materials is allowed.

8 Uses in buildings must be compatible.

9 Use compatible only if requirements of California Education Code, Sections 39005.7, 81036 and 81038 are fulfilled.

10 No chapels or funeral homes.

11 No club houses, bars, restaurants or banquet facilities. Ancillary uses such as pro shops, snack bars, and specialty food and beverage services are allowed. New course layouts & revisions to existing courses must be reviewed by ALUC for safety impacts. This restriction does not apply to the Metro Air Park Special Planning Area.

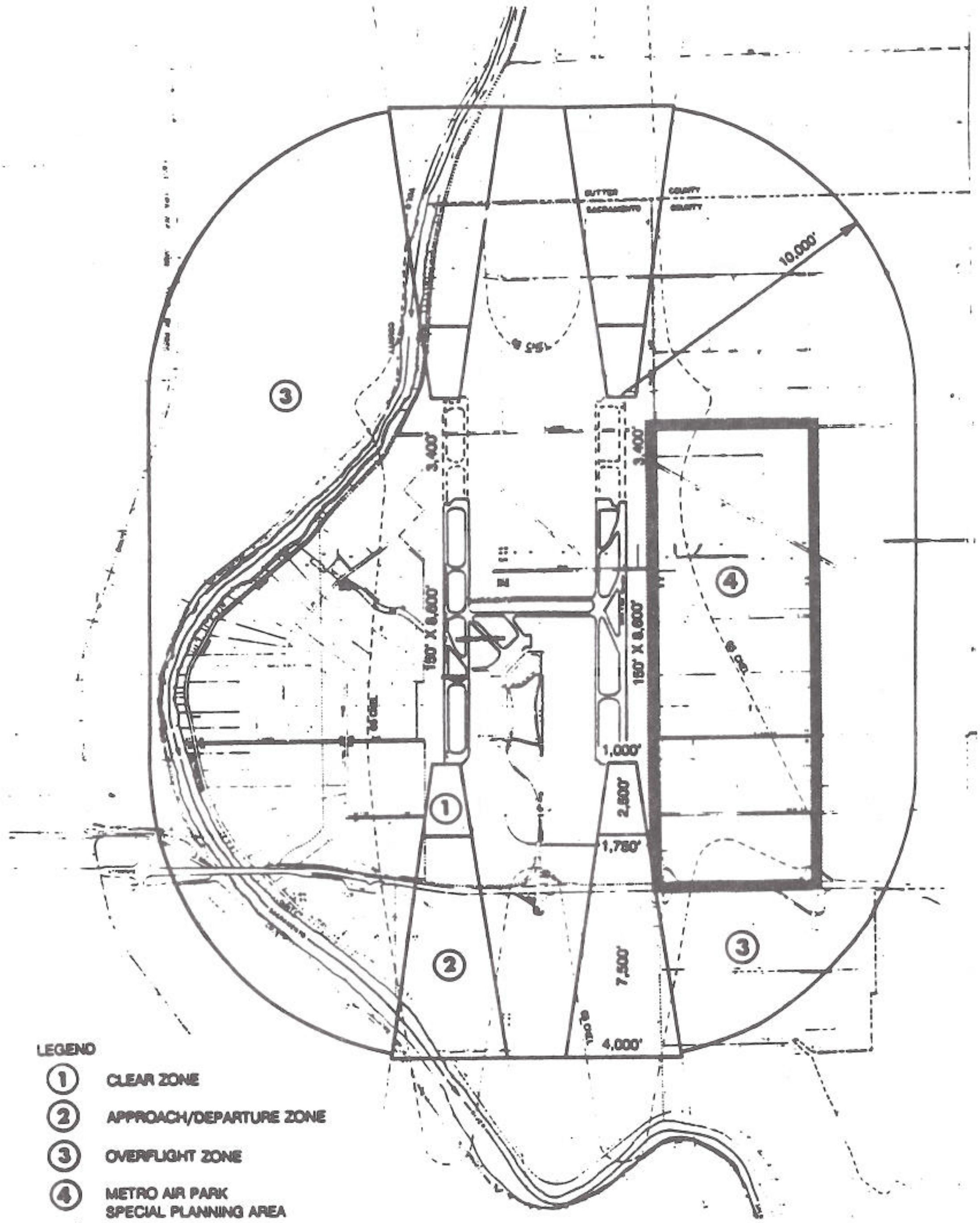
12 No high intensity uses or facilities, such as structured playgrounds, ballfields, or picnic pavilions.

13 Uses compatible only if they do not result in a large concentration of people. A large concentration of people is defined as a gathering of individuals in an area that would result in an average density of greater than 25 persons per acre per hour during any 24 hour period ending at midnight, not to exceed 50 persons per acre at any time. This restriction does not apply to non-residential uses in the Metro Air Park Special Planning Area.

14 No uses that would cause electrical interference that would be detrimental to the operation of aircraft or aircraft instrumentation.

SACMETRO\SAFETY

Exhibit C-11A Continued



Source: Sacramento Metropolitan Airport Comprehensive Land Use Plan (1993)

Exhibit C-11B

Airport Safety Zones

Sacramento Metropolitan Airport

AIRPORT LAND USE COMPATIBILITY LISTING

USES	AREAS 1	2	3	4	5	6
AGRICULTURAL USES						
TRUCK & SPECIALTY CROPS	O	O	O	O	O	O
FIELD CROPS	O	O	O	O	O	O
PASTURE & RANGELAND	O	O	O	O	O	O
ORCHARD & VINEYARDS	X	X	O	O	O	O
DRY FARM & GRAIN	O	O	O	O	O	O
TREE FARMS, LANDSCAPE NURSERIES & GREENHOUSES	O	O	O	O	O	O
FISH FARMS	X	X	O	O	O	O
FEED LOTS & STOCKYARDS	X	X	O	O	O	O
POULTRY FARMS	X	X	C	C	O	O
DAIRY FARMS	X	X	O	O	O	O
NATURAL USES						
FOREST RESERVES	X	X	O	O	O	O
FISH & GAME RESERVES	X	X	O	O	O	O
LAND RESERVES & OPEN SPACE	O	O	O	O	O	O
FLOOD & GEOLOGICAL HAZARD AREAS	O	O	O	O	O	O
WATERWAYS - RIVERS, CREEKS, CANALS, SWAMPS, BAY, LAKES	O	O	O	O	O	O
RESIDENTIAL & INSTITUTIONAL						
RURAL RESIDENTIAL - 5 ACRES OR MORE	X	X	C	C	O	O
SUBURBAN RESIDENTIAL - 5 ACRES OR LESS	X	X	X	C	C	O
SINGLE FAMILY (6,000 SQ. FT.)	X	X	X	C	C	O
MULTI-FAMILY	X	X	X	X	C	O
MOBILE HOME PARKS	X	X	X	C	C	O
SCHOOLS, COLLEGES & UNIVERSITIES	X	X	X	X	C	C
HOSPITALS	C	C	X	X	C	O
CHURCHES	X	X	X	X	C	O
RECREATIONAL						
GOLF COURSES	O	O	O	O	O	O
PARKS	O	O	O	O	O	O
PLAYGROUNDS & PICNIC AREAS	O	O	O	O	O	O
ATHLETIC FIELDS	X	X	X	C	C	O
RIDING STABLES & TRAILS	X	X	O	O	O	O
MARINAS	O	O	O	O	O	O
TENNIS COURTS	O	O	O	O	O	O
OUTDOOR THEATERS	X	X	X	X	C	O
SWIMMING POOLS	O	O	O	O	O	O
FAIRGROUNDS & RACETRACKS	X	X	X	X	C	O

USES	AREAS 1	2	3	4	5	6
COMMERCIAL USES						
AIRCRAFT SALES & REPAIRS	O	O	O	O	O	O
FLYING SCHOOLS	C	C	C	C	C	O
HOTELS & MOTELS	C	C	X	C	C	O
SHOPPING CENTERS	C	C	X	C	O	O
BANKS	C	C	X	O	O	O
GAS STATIONS	C	C	X	O	O	O
AUTO STORAGE & PARKING	O	O	O	O	O	O
OFFICE BUILDINGS	C	C	C	C	O	O
THEATERS & AUDITORIUMS	X	X	X	C	C	O
PUBLIC BUILDINGS	C	C	C	C	O	O
TAXI, BUS & TERMINALS	O	O	X	O	O	O
MEMORIAL PARKS	X	X	X	O	O	O
PET CEMETERIES	X	X	X	O	O	O
RESTAURANTS & FOOD TAKE-OUTS	C	C	C	C	O	O
RETAIL STORES	C	C	C	C	O	O
TRUCK TERMINALS	O	O	O	O	O	O
OTHER SERVICE USES	C	C	C	C	O	O
INDUSTRIAL						
RESEARCH LABORATORIES	C	C	C	C	O	O
WAREHOUSES	O	O	O	O	O	O
AIRCRAFT FACTORIES	O	O	C	O	O	O
AIR FREIGHT TERMINALS	O	O	O	O	O	O
NON-AIR RELATED MANUFACTURING	C	C	C	O	O	O
RAIL SIDINGS	O	O	O	O	O	O
OTHER TRANSPORTATION PARKS	O	O	O	O	O	O
UTILITIES						
RESERVOIRS	C	C	O	O	O	O
WATER TREATMENT	C	C	O	O	O	O
SEWAGE DISPOSAL	C	C	O	O	O	O
PETROLEUM AND CHEMICAL PRODUCTS BULK STORAGE	C	C	C	O	O	O
ELECTRICAL PLANTS	X	X	C	O	O	O
POWER LINES	C	C	C	O	O	O

X - PROHIBITED O - COMPATIBLE C - CONDITIONALLY APPROVABLE

Source: Airport Land Use Plan: San Luis Obispo County Airport (1979)

Exhibit C-12A

Airport Land Use Compatibility Listing

San Luis Obispo County Airport

LAND USE AREAS

1-IN AIRPORT BUILDING AREAS
2-ON OTHER AIRPORT PROPERTY
3-UNDER APPROACH & CLIMBOUT EXTENSIONS
4-LAND ADJACENT TO AIRPORT BETWEEN RUNWAY EXTENSIONS
5-OTHER LAND BETWEEN RUNWAY EXTENSIONS
6-OTHER LAND IN PLANNING AREA
* AIRPORT LAND USE COMMISSION TO BE ADVISED OF PROPOSED DEVELOPMENT IN THIS AREA

Source: Airport Land Use Plan: San Luis Obispo County Airport (1979)

Exhibit C-12B

Land Use Areas

San Luis Obispo County Airport

Exhibit 9

AIRPORT/LAND USE SAFETY COMPATIBILITY CRITERIA

LAND USE CHARACTERISTIC	SAFETY ZONES[1/]				
	Clear Zones	Inner Approach Zones[2/]	Transitional Zones	Outer Approach Zones & Beneath Flight Track	Horizontal & Conical Zones
Residential Uses	-	(A)	(B,E)	(B,E)	+
Other Uses In Structures	-	(C,E)	(D,E)	+	+
Other Uses Not In Structures	(C,F)	(D)	+	+	+
Special Characteristics					
Distracting Lights or Glare	-	-	-	-	(F)
Sources of Smoke or Electronic Interference	-	-	-	-	(F)
Attractor of Birds	-	-	-	(F)	+

NOTES 1/ Where safety zones overlap, the more restrictive criterion applies.

2/ For the purposes herein, the inner approach zone is defined as having a length of approximately 7,500 feet for existing or planned precision instrument runways (Sonoma County Airport Runway 32), 5,100 feet for existing or planned nonprecision instrument runways (Sonoma County Airport Runways 14, 1, and 19), and 3,000 feet for visual runways (all others).

INTERPRETATION

+ ACCEPTABLE: Use is acceptable with little or no risks.

( ) CONDITIONALLY ACCEPTABLE: Hazards exist, but use is acceptable under conditions cited below.

A Density no greater than 1 dwelling unit per 3 acres.
B Density no greater than 4 dwelling units per acre.
C Occupancy no greater than 25 persons per acre at any time.
D Occupancy no greater than 50 persons per acre at any time.
E Maximum structural coverage 25% with 30% of area open (aircraft could make emergency landing without damage to structures on ground).
F. Characteristic cannot reasonably be avoided or located outside of indicated safety zone.

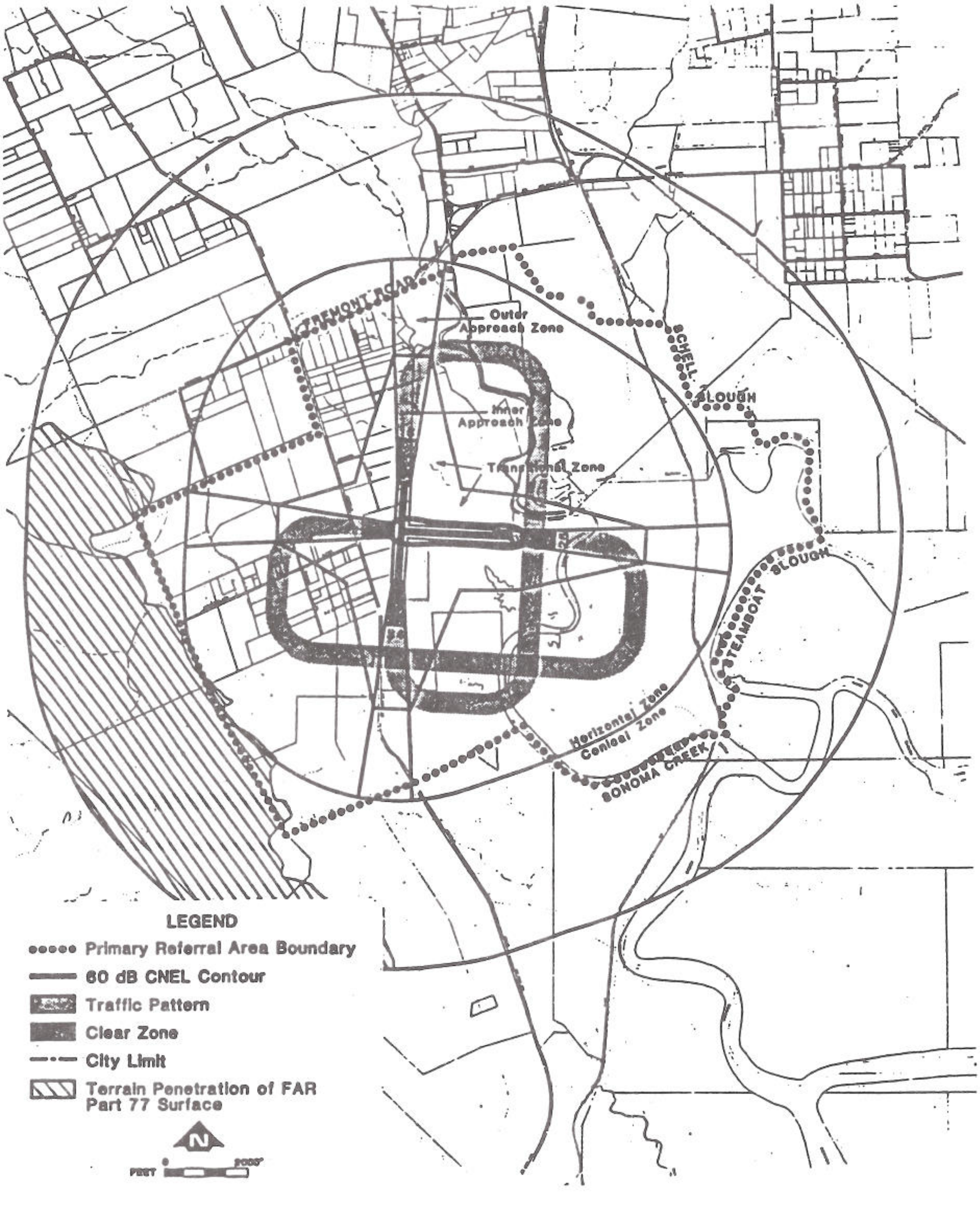
\- UNACCEPTABLE: Use is unacceptable due to associated hazards.

Source: Sonoma County Airport Land Use Policy Plan (1981)

Exhibit C-13A

Airport/Land Use Safety Compatibility Criteria

Sonoma Valley Airport



Source: *Sonoma County Airport Land Use Policy Plan (1981)*

Exhibit C-13B

Airport Referral Area

Sonoma Valley Airport

Appendix D

Sample Implementation Documents

Appendix D
Sample Implementation Documents

Some compatibility plans require the dedication of avigation or overflight easements or use of deed notices in selected areas around each of the airports in the county. The specific applications are discussed in Chapter 5.

Examples of three types of documents are presented on the following pages.

Exhibit D1 — Avigation Easement

Exhibit D2 — Overflight Easement

Exhibit D3 — Deed Notice

Exhibit D1
Typical Avigation Easement

This indenture made this ____ day of ____________, 19 __, between ______________________________ hereinafter referred to as Grantor, and the [Insert County or City name], a political subdivision in the State of California, hereinafter referred to as Grantee.

The Grantor, for good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, does hereby grant to the Grantee, its successors and assigns, a perpetual and assignable easement over the following described parcel of land in which the Grantor holds a fee simple estate. The property which is subject to this easement is depicted as ______________________________ on "Exhibit A" attached and is more particularly described as follows:

[Insert legal description of real property]

The easement applies to the Airspace above an imaginary plane over the real property. The plane is described as follows:

> The imaginary plane above the hereinbefore described real property, as such plane is defined by Part 77 of the Federal Aviation Regulations, and consists of a plane [describe approach, transition, or horizontal surface]; the elevation of said plane being based upon the ____________Airport official runway end elevation of _____ feet Above Mean Sea Level (AMSL), as determined by [Insert name and Date of Survey or Airport Layout Plan that determines the elevation] the approximate dimensions of which said plane are described and shown on Exhibit A attached hereto and incorporated herein by reference.

The aforesaid easement and right-of-way includes, but is not limited to:

(1) For the use and benefit of the public, the easement and continuing right to fly, or cause or permit the flight by any and all persons, or any aircraft, of any and all kinds now or hereafter known, in, through, across, or about any portion of the Airspace hereinabove described; and

(2) The easement and right to cause or create, or permit or allow to be caused or created within all space above the existing surface of the hereinabove described real property and any and all Airspace laterally adjacent to said real property, such noise, vibration, currents and other effects of air, illumination and fuel consumption as may be inherent in, or may arise or occur from or during the operation of aircraft of any and all kinds, now or hereafter known or used, for navigation of or flight in air; and

(3) A continuing right to clear and keep clear from the Airspace any portions of buildings, structures, or improvements of any kinds, and of trees or other objects, including the right to remove or demolish those portions of such buildings, structures, improvements, trees, or other things which extend into or above said Airspace, and the right to cut to the ground level and remove, any trees which extend into or above the Airspace; and

(4) The right to mark and light, or cause or require to be marked or lighted, as obstructions to air navigation, any and all buildings, structures, or other improvements, and trees or other objects, which extend into or above the Airspace; and

(5) The right of ingress to, passage within, and egress from the hereinabove described real property, for the purposes described in subparagraphs (3) and (4) above at reasonable times and after reasonable notice.

For and behalf of itself, its successors and assigns, the Grantor hereby covenants with the [Insert County or City name], for the direct benefit of the real property constituting the _______________ Airport hereinafter described, that neither the Grantor, nor its successors in interest or assigns will construct, install, erect, place or grow in or upon the hereinabove described real property, nor will they permit to allow, any building structure, improvement, tree or other object which extends into or above the Airspace, or which constitutes an obstruction to air navigation, or which obstructs or interferes with the use of the easement and rights-of-way herein granted.

The easements and rights-of-way herein granted shall be deemed both appurtenant to and for the direct benefit of that real property which constitutes the _____________ Airport, in the [Insert County or City name], State of California; and shall further be deemed in gross, being conveyed to the Grantee for the benefit of the Grantee and any and all members of the general public who may use said easement or right-of-way, in landing at, taking off from or operating such aircraft in or about the _____________ Airport, or in otherwise flying through said Airspace.

This grant of easement shall not operate to deprive the Grantor, its successors or assigns, of any rights which may from time to time have against any air carrier or private operator for negligent or unlawful operation of aircraft.

These covenants and agreements run with the land and are binding upon the heirs, administrators, executors, successors and assigns of the Grantor, and, for the purpose of this instrument, the real property firstly hereinabove described is the servient tenement and said ______________ Airport is the dominant tenement.

DATED: ______________ ____

____

STATE OF } ss

COUNTY OF }

On __________________, before me, the undersigned, a Notary Public in and for said County and State, personally appeared __________________, and __________________ known to me to be the persons whose names are subscribed to the within instrument and acknowledged that they executed the same.

WITNESS my hand and official seal.

____

Notary Public

Exhibit D2

Typical Overflight Easement

GRANTOR hereby grants to the ________________ in ________________, its successors or assigns, as owners of the [Name of Airport]________________, California, an overflight easement for the following purposes and granting the following rights:

(1) For the use and benefit of the public, and to the extent and in the manner consistent with safe operating procedures as provided under applicable governmental regulations, the right to make flights, and the noise inherent thereto, in airspace over the property described in Exhibit A (attached) in connection with landings, takeoffs, and general operation of the [Name of Airport].

(2) The right to regulate or prohibit the release into the air of any substance which would impair the visibility or otherwise interfere with the operations of aircraft such as, but not limited to, steam, dust, and smoke.

(3) The right to regulate or prohibit light emissions, either direct or indirect (reflective), which might interfere with pilot vision.

(4) The right to prohibit electrical emissions which would interfere with aircraft communication systems or aircraft navigational equipment.

This easement shall be effective from this date and run with the land until such time as the [Name of Airport]________ is no longer used as an airport.

The real property subject to this overflight easement is described as follows:

See Attachment "A"

DATED: ____________________ GRANTOR: ________________________________

____

By: ________________________________

Exhibit D3
Sample Deed Notice

The following statement should be included on the deed for the subject property and recorded in by the County. This statement should also be included on any parcel map, tentative map or final map for subdivision approval.

> This property is in the area subject to overflights by aircraft using ____________ airport, and as a result, residents may experience inconvenience, annoyance or discomfort arising from the noise of such operations. State law (public utilities code section 21670 et. Seq.) establishes the importance of public use airports to protection of the public interest of the people of the State of California. Residents of property near a public use airport should therefore be prepared to accept such inconvenience, annoyance or discomfort from normal aircraft operations. Any subsequent deed conveying parcels or lots shall contain a statement in substantially this form.

Appendix E

Federal Aviation Administration Runway Approach Protection Standards

Appendix E

Federal Aviation Administration Runway Approach Protection Standards

Federal Aviation Regulations
Part 77 — Objects Affecting Navigable Airspace

Subpart A—General

§ 77.1 Scope.

This Part—

(a) Establishes standards for determining obstructions in navigable airspace;

(b) Sets forth the requirements for notice to the Administrator of certain proposed construction or alteration;

(c) Provides for aeronautical studies of obstructions to air navigation, to determine their effect on the safe and efficient use of airspace;

(d) Provides for public hearings on the hazardous effect of proposed construction or alteration on air navigation; and

(e) Provides for establishing antenna farm areas.

§ 77.2 Definition of terms.

For the purpose of this Part:

"Airport available for public use" means an airport that is open to the general public with or without a prior request to use the airport.

"A seaplane base" is considered to be an airport only if its sea lanes are outlined by visual markers.

"Nonprecision instrument runway" means a runway having an existing instrument approach procedure utilizing air navigation facilities with only horizontal guidance, or area type navigation equipment, for which a straight-in nonprecision instrument approach procedure has been approved, or planned, and for which no precision approach facilities are planned, or indicated on an FAA planning document or military service military airport planning document.

"Precision instrument runway" means a runway having an existing instrument approach procedure utilizing an Instrument Landing System (ILS), or a Precision Approach Radar (PAR). It also means a runway for which a precision approach system is planned and is so indicated by an FAA approved airport layout plan; a military service approved military airport layout plan; any other FAA planning document, or military service military airport planning document.

"Utility runway" means a runway that is constructed for and intended to be used by propeller driven aircraft of 12,500 pounds maximum gross weight and less.

"Visual runway" means a runway intended solely for the operation of aircraft using visual approach procedures, with no straight-in instrument approach procedure and no instrument designation indicated on an FAA approved airport layout plan, a military service approved military airport layout plan, or by any planning document submitted to the FAA by competent authority.

§ 77.3 Standards.

(a) The standards established in this Part for determining obstructions to air navigation are used by the Administrator in—

(1) Administering the Federal-aid Airport Program and the Surplus Airport Program;

(2) Transferring property of the United States under Section 16 of the Federal Airport Act;

(3) Developing technical standards and guidance in the design and construction of airports; and

(4) Imposing requirements for public notice of the construction or alteration of any structure where notice will promote air safety.

(b) The standards used by the Administrator in the establishment of flight procedures and aircraft operational limitations are not set forth in this Part but are contained in other publications of the Administrator.

§ 77.5 Kinds of objects affected.

This Part applies to—

(a) Any object of natural growth, terrain, or permanent or temporary construction or alteration, including equipment or materials used therein, and apparatus of a permanent or temporary character; and

(b) Alteration of any permanent or temporary existing structure by a change in its height (including appurtenances), or lateral dimensions, including equipment or materials used therein.

Subpart B—Notice of Construction or Alteration

§ 77.11 Scope.

(a) This subpart requires each person proposing any kind of construction or alteration described in § 77.13(a) of this chapter to give adequate notice to the Administrator. It specifies the locations and dimensions of the construction or alteration for which notice is required and prescribes the form and manner of the notice. It also requires supplemental notices 48 hours before the start and upon the completion of certain construction or alteration that was the subject of a notice under § 77.13(a).

(b) Notices received under this subpart provide a basis for—

(1) Evaluating the effect of the construction or alteration on operational procedures and proposed operational procedures;

(2) Determinations of the possible hazardous effect of the proposed construction or alteration on air navigation;

(3) Recommendations for identifying the construction or alteration in accordance with the current Federal Aviation Administration Advisory Circular AC 70/7460-1 entitled "Obstruction Marking and Lighting," which is available without charge from the Department of Transportation, Distribution Unit, TAD 484.3, Washington, D.C. 20590;

(4) Determining other appropriate measures to be applied for continued safety of air navigation; and

(5) Charting and other notification to airmen of the construction or alteration.

§ 77.13 Construction or alteration requiring notice.

(a) Except as provided in § 77.15, each sponsor who proposes any of the following construction or alteration shall notify the Administrator in the form and manner prescribed in § 77.17:

(1) Any construction or alteration of more than 200 feet in height above the ground level at its site.

(2) Any construction or alteration of greater height than an imaginary surface extending outward and upward at one of the following slopes:

(i) 100 to 1 for a horizontal distance of 20,000 feet from the nearest point of the nearest runway of each airport specified in subparagraph (5) of this paragraph with at least one runway more than 3,200 feet in actual length, excluding heliports.

(ii) 50 to 1 for a horizontal distance of 10,000 feet from the nearest point of the nearest runway of each airport specified in subparagraph (5) of this paragraph with its longest runway no more than 3,200 feet in actual length, excluding heliports.

(iii) 25 to 1 for a horizontal distance of 5,000 feet from the nearest point of the nearest landing and takeoff area of each heliport specified in subparagraph (5) of this paragraph.

(3) Any highway, railroad, or other traverse way for mobile objects, of a height which, if adjusted upward 17 feet for an Interstate Highway that is part of the National System of Military and Interstate Highways where overcrossings are designed for a minimum of 17 feet vertical distance, 15 feet for any other public roadway, 10 feet or the height of the highest mobile object that would normally traverse the road, whichever is greater, for a private road, 23 feet for a railroad, and for a waterway or any other traverse way not previously mentioned, an amount equal to the height of the highest mobile object that would normally

traverse it, would exceed a standard of paragraph (1) or (2) of this section.

(4) When requested by the FAA, any construction or alteration that would be in an instrument approach area (defined in the FAA standards governing instrument approach procedures) and available information indicates it might exceed a standard of Subpart C of this part.

(5) Any construction or alteration on any of the following airports (including heliports):

(i) An airport that is available for public use and is listed in the Airport Directory of the current Airman's Information Manual or in either the Alaska or Pacific Airman's Guide and Chart Supplement.

(ii) An airport under construction, that is the subject of a notice or proposal on file with the Federal Aviation Administration, and, except for military airports, it is clearly indicated that the airport will be available for public use.

(iii) An airport that is operated by an armed force of the United States.

(b) Each sponsor who proposes construction or alteration that is the subject of a notice under paragraph (a) of this section and is advised by an FAA regional office that a supplemental notice is required shall submit that notice on a prescribed form to be received by the FAA regional office at least 48 hours before the start of the construction or alteration.

(c) Each sponsor who undertakes construction or alteration that is the subject of a notice under paragraph (a) of this section shall, within 5 days after that construction or alteration reaches its greatest height, submit a supplemental notice on a prescribed form to the FAA regional office having jurisdiction over the region involved, if—

(1) The construction or alteration is more than 200 feet above the surface level of its site; or

(2) An FAA regional office advises him that submission of the form is required.

§ 77.15 Construction or alteration not requiring notice.

No person is required to notify the Administrator for any of the following construction or alteration:

(a) Any object that would be shielded by existing structures of a permanent and substantial character or by natural terrain or topographic features of equal or greater height, and would be located in the congested area of a city, town, or settlement where it is evident beyond all reasonable doubt that the structure so shielded will not adversely affect safety in air navigation.

(b) Any antenna structure of 20 feet or less in height except one that would increase the height of another antenna structure.

(c) Any air navigation facility, airport visual approach or landing aid, aircraft arresting device, or meteorological device, of a type approved by the Administrator, or an appropriate military service on military airports, the location and height of which is fixed by its functional purpose.

(d) Any construction or alteration for which notice is required by any other FAA regulation.

§ 77.17 Form and time of notice.

(a) Each person who is required to notify the Administrator under § 77.13(a) shall send one executed form set (four copies) of FAA Form 7460–1, Notice of Proposed Construction or Alteration, to the 【Manager】, Air Traffic Division, FAA Regional Office having jurisdiction over the area within which the construction or alteration will be located. Copies of FAA Form 7460–1 may be obtained from the headquarters of the Federal Aviation Administration and the regional offices.

(b) The notice required under § 77.13(a) (1) through (4) must be submitted at least 30 days before the earlier of the following dates—

(1) The date the proposed construction or alteration is to begin.

(2) The date an application for a construction permit is to be filed.

However, a notice relating to proposed construction or alteration that is subject to the licensing requirements of the Federal Communications Act may be sent to the FAA at the same time the application for construction is filed with the Federal Communications Commission, or at any time before that filing.

(c) A proposed structure or an alteration to an existing structure that exceeds 2,000 feet in height above the ground will be presumed to be a hazard to air navigation and to result in an inefficient utilization of airspace and the applicant has the burden of overcoming that presumption. Each notice submitted under the pertinent provisions of this Part 77 proposing a structure in excess of 2,000 feet above ground, or an alteration that will make an existing structure exceed that height, must contain a detailed showing, directed to meeting this burden. Only in exceptional cases, where the FAA concludes that a clear and compelling showing has been made that it would not result in an inefficient utilization of the airspace and would not result in a hazard to air navigation, will a determination of no hazard be issued.

(d) In the case of an emergency involving essential public services, public health, or public safety that requires immediate construction or alteration, the 30-day requirement in paragraph (b) of this section does not apply and the notice may be sent by telephone, telegraph, or other expeditious means, with an executed FAA Form 7460-1 submitted within five days thereafter. Outside normal business hours, emergency notices by telephone or telegraph may be submitted to the nearest FAA Flight Service Station.

(e) Each person who is required to notify the Administrator by paragraph (b) or (c) of § 77.13, or both, shall send an executed copy of FAA Form 117-1, Notice of Progress of Construction or Alteration, to the [Manager], Air Traffic Division, FAA Regional Office having jurisdiction over the area involved.

§ 77.19 Acknowledgment of notice.

(a) The FAA acknowledges in writing the receipt of each notice submitted under § 77.13 (a).

(b) If the construction or alteration proposed in a notice is one for which lighting or marking standards are prescribed in the FAA Advisory Circular AC 70/7460-1 entitled "Obstruction Marking and Lighting," the acknowledgment contains a statement to that effect and information on how the structure should be marked and lighted in accordance with the manual.

(c) The acknowledgment states that an aeronautical study of the proposed construction or alteration has resulted in a determination that the construction or alteration—

(1) Would not exceed any standard of Subpart C and would not be a hazard to air navigation;

(2) Would exceed a standard of Subpart C but would not be a hazard to air navigation; or

(3) Would exceed a standard of Subpart C and further aeronautical study is necessary to determine whether it would be hazard to air navigation, that the sponsor may request within 30 days that further study, and that, pending completion of any further study, it is presumed the construction or alteration would be a hazard to air navigation.

Subpart C—Obstruction Standards

§ 77.21 Scope.

(a) This subpart establishes standards for determining obstructions to air navigation. It applies to existing and proposed manmade objects, objects of natural growth, and terrain. The standards apply to the use of navigable airspace by aircraft and to existing air navigation facilities, such as an air navigation aid, airport, Federal airway, instrument approach or departure procedure, or approved off-airway route. Additionally, they apply to a planned facility or use, or a change in an existing facility or use, if a proposal therefor is on file with the Federal Aviation Administration or an appropriate military service on the date the notice required by § 77.13(a) is filed.

(b) At those airports having defined runways with specially prepared hard surfaces, the primary surface for each such runway extends 200 feet beyond each end of the runway. At those airports having defined strips or pathways that are used regularly for the taking off and landing of aircraft and have been designated by approriate authority as runways, but do not have specially prepared hard surfaces, each end of the primary surface for each such runway shall coincide with the corresponding end of the runway. At those airports, excluding seaplane bases, having a defined landing and takeoff area with no defined pathways for the landing and taking off of aircraft, a determination shall be made as to which portions of the landing and takeoff area are regularly used as landing and takeoff pathways. Those pathways so determined shall be considered runways and an appropriate primary surface as defined in § 77.25(c) will be considered as being longitudinally centered on each runway so determined, and each end of that primary surface shall coincide with the corresponding end of that runway.

(c) The standards in this subpart apply to the effect of construction or alteration proposals upon an airport if, at the time of filing of the notice required by § 77.13(a), that airport is—

(1) Available for public use and is listed in the Airport Directory of the current Airman's Information Manual or in either the Alaska or Pacific Airman's Guide and Chart Supplement; or,

(2) A planned or proposed airport or an airport under construction, that is the subject of a notice or proposal on file with the Federal Aviation Administration, and, except for military airports, it is clearly indicated that that airport will be available for public use; or,

(3) An airport that is operated by an armed force of the United States.

(d) [Deleted]

§ 77.23 Standards for determining obstructions.

(a) An existing object, including a mobile object, is, and a future object would be, an obstruction to air navigation if it is of greater height than any of the following heights or surfaces:

(1) A height of 500 feet above ground level at the site of the object.

(2) A height that is 200 feet above ground level or above the established airport elevation, whichever is higher, within 3 nautical miles of the established reference point of an airport, excluding heliports, with its longest runway more than 3,200 feet in actual length, and that height increases in the proportion of 100 feet for each additional nautical mile of distance from the airport up to a maximum of 500 feet.

(3) A height within a terminal obstacle clearance area, including an initial approach segment, a departure area, and a circling approach area, which would result in the vertical distance between any point on the object and an established minimum instrument flight altitude within that area or segment to be less than the required obstacle clearance.

(4) A height within an en route obstacle clearance area, including turn and termination areas, of a Federal airway or approved off-airway route, that would increase the minimum obstacle clearance altitude.

(5) The surface of a takeoff and landing area of an airport or any imaginary surface established under §§ 77.25, 77.28, or 77.29. However, no part of the takeoff or landing area itself will be considered an obstruction.

(b) Except for traverse ways on or near an airport with an operative ground traffic control service, furnished by an air traffic control tower or by the airport management and coordinated with the air traffic control service, the standards of paragraph (a) of this section apply to traverse ways used or to be used for the passage of mobile objects only after the heights of these traverse ways are increased by:

(1) Seventeen feet for an Interstate Highway that is part of the National System of Military and Interstate Highways where overcrossings are designed for a minimum of 17 feet vertical distance.

(2) Fifteen feet for any other public roadway.

(3) Ten feet or the height of the highest mobile object that would normally traverse the road, whichever is greater, for a private road.

(4) Twenty-three feet for a railroad.

(5) For a waterway or any other traverse way not previously mentioned, an amount equal to the height of the highest mobile object that would normally traverse it.

§ 77.25 Civil airport imaginary surfaces.

The following civil airport imaginary surfaces are established with relation to the airport and to each runway. The size of each such imaginary surface is based on the category of each runway according to the type of approach available or planned for that runway. The slope and dimensions of the approach surface applied to each end of a runway are determined by the most precise approach existing or planned for that runway end.

(a) Horizontal surface—a horizontal plane 150 feet above the established airport elevation, the perimeter of which is constructed by swinging arcs of specified radii from the center of each end of the primary surface of each runway of each airport and connecting the adjacent arcs by lines tangent to those arcs. The radius of each arc is:

(1) 5,000 feet for all runways designated as utility or visual;

(2) 10,000 feet for all other runways.

The radius of the arc specified for each end of a runway will have the same arithmetical value. That value will be the highest determined for either end of the runway. When a 5,000-foot arc is encompassed by tangents connecting two adjacent 10,000-foot arcs, the 5,000-foot arc shall be disregarded on the construction of the perimeter of the horizontal surface.

(b) Conical surface—a surface extending outward and upward from the periphery of the horizontal surface at a slope of 20 to 1 for a horizontal distance of 4,000 feet.

(c) Primary surface—a surface longitudinally centered on a runway. When the runway has a specially prepared hard surface, the primary surface extends 200 feet beyond each end of that runway; but when the runway has no specially prepared hard surface, or planned hard surface, the primary surface ends at each end of that runway. The elevation of any point on the primary surface is the same as the elevation of the nearest point on the runway centerline. The width of a primary surface is:

(1) 250 feet for utility runways having only visual approaches.

(2) 500 feet for utility runways having nonprecision instrument approaches.

(3) For other than utility runways the width is:

(i) 500 feet for visual runways having only visual approaches.

(ii) 500 feet for nonprecision instrument runways having visibility minimums greater than three-fourths statute mile.

(iii) 1,000 feet for a nonprecision instrument runway having a nonprecision instrument approach with visibility minimums as low as three-fourths of a statute mile, and for precision instrument runways.

The width of the primary surface of a runway will be that width prescribed in this section for the most precise approach existing or planned for either end of that runway.

(d) Approach surface—a surface longitudinally centered on the extended runway centerline and extending outward and upward from each end of the primary surface. An approach surface is applied to each end of each runway based upon the type of approach available or planned for that runway end.

(1) The inner edge of the approach surface is the same width as the primary surface and it expands uniformly to a width of:

(i) 1,250 feet for that end of a utility runway with only visual approaches;

(ii) 1,500 feet for that end of a runway other than a utility runway with only visual approaches;

(iii) 2,000 feet for that end of a utility runway with a nonprecision instrument approach;

(iv) 3,500 feet for that end of a nonprecision instrument runway other than utility, having visibility minimums greater than three-fourths of a statute mile;

(v) 4,000 feet for that end of a nonprecision instrument runway, other than utility, having a nonprecision instrument approach with visibility minimums as low as three-fourths statute mile; and

(vi) 16,000 feet for precision instrument runways.

(2) The approach surface extends for a horizontal distance of:

(i) 5,000 feet at a slope of 20 to 1 for all utility and visual runways;

(ii) 10,000 feet at a slope of 34 to 1 for all nonprecision instrument runways other than utility; and,

(iii) 10,000 feet at a slope of 50 to 1 with an additional 40,000 feet at a slope of 40 to 1 for all precision instrument runways.

(3) The outer width of an approach surface to an end of a runway will be that width prescribed in this subsection for the most precise approach existing or planned for that runway end.

(e) *Transitional surface*—These surfaces extend outward and upward at right angles to the runway centerline and the runway centerline extended at a slope of 7 to 1 from the sides of the primary surface and from the sides of the approach surfaces. Transitional surfaces for those portions of the precision approach surface which project through and beyond the limits of the conical surface, extend a distance of 5,000 feet measured horizontally from the edge of the approach surface and at right angles to the runway centerline.

§ 77.27 [Revoked]

§ 77.28 Military airport imaginary surfaces.

(a) *Related to airport reference points.* These surfaces apply to all military airports. For the purposes of this section a military airport is any airport operated by an armed force of the United States.

(1) *Inner horizontal surface*—A plane is oval in shape at a height of 150 feet above the established airfield elevation. The plane is constructed by scribing an arc with a radius of 7,500 feet about the centerline at the end of each runway and interconnecting these arcs with tangents.

(2) *Conical surface*—A surface extending from the periphery of the inner horizontal surface outward and upward at a slope of 20 to 1 for a horizontal distance of 7,000 feet to a height of 500 feet above the established airfield elevation.

(3) *Outer horizontal surface*—A plane, located 500 feet above the established airfield elevation, extending outward from the outer periphery of the conical surface for a horizontal distance of 30,000 feet.

(b) *Related to runways.* These surfaces apply to all military airports.

(1) Primary surface—A surface located on the ground or water longitudinally centered on each runway with the same length as the runway. The width of the primary surface for runways is 2,000 feet. However, at established bases where substantial construction has taken place in accordance with a previous lateral clearance criteria, the 2,000-foot width may be reduced to the former criteria.

(2) *Clear zone surface*—A surface located on the ground or water at each end of the primary surface, with a length of 1,000 feet and the same width as the primary surface.

(3) *Approach clearance surface*—An inclined plane, symmetrical about the runway centerline extended, beginning 200 feet beyond each end of the primary surface at the centerline elevation of the runway end and extending for 50,000 feet. The slope of the approach clearance surface is 50 to 1 along the runway centerline extended until it reaches an elevation of 500 feet above the established airport elevation. It then continues horizontally at this elevation to a point 50,000 feet from the point of beginning. The width of this surface as the runway end is the same as the primary surface, it flares uniformly, and the width at 50,000 is 16,000 feet.

(4) *Transitional surfaces*—These surfaces connect the primary surfaces, the first 200 feet of the clear zone surfaces, and the ap-

proach clearance surfaces to the inner horizontal surface, conical surface, outer horizontal surface or other transitional surfaces. The slope of the transitional surface is 7 to 1 outward and upward at right angles to the runway centerline.

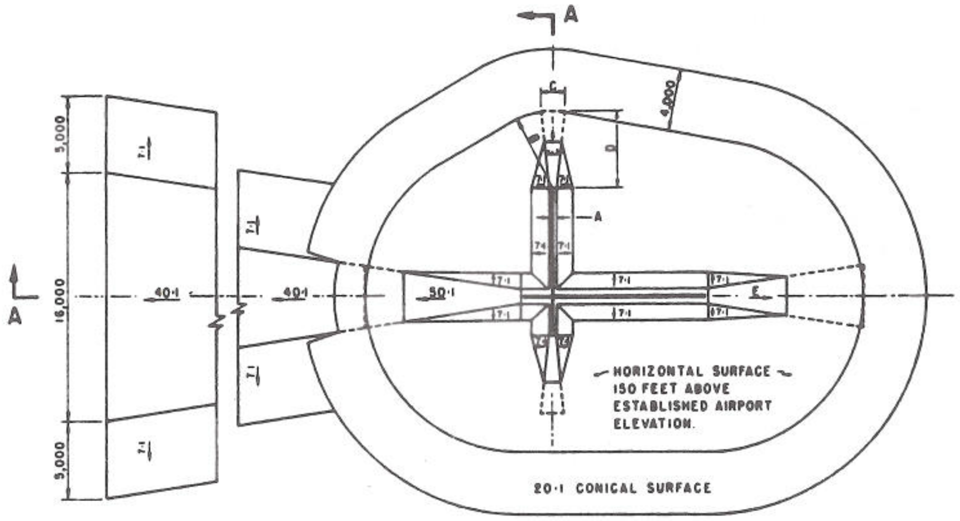
§ 77.29 Airport imaginary surfaces for heliports.

(a) *Heliport primary surface.* The area of the primary surface coincides in size and shape with the designated takeoff and landing area of a heliport. This surface is a horizontal plane at the elevation of the established heliport elevation.

(b) *Heliport approach surface.* The approach surface begins at each end of the heliport primary surface with the same width as the primary surface, and extends outward and upward for a horizontal distance of 4,000 feet where its width is 500 feet. The slope of the approach surface is 8 to 1 for civil heliports and 10 to 1 for military heliports.

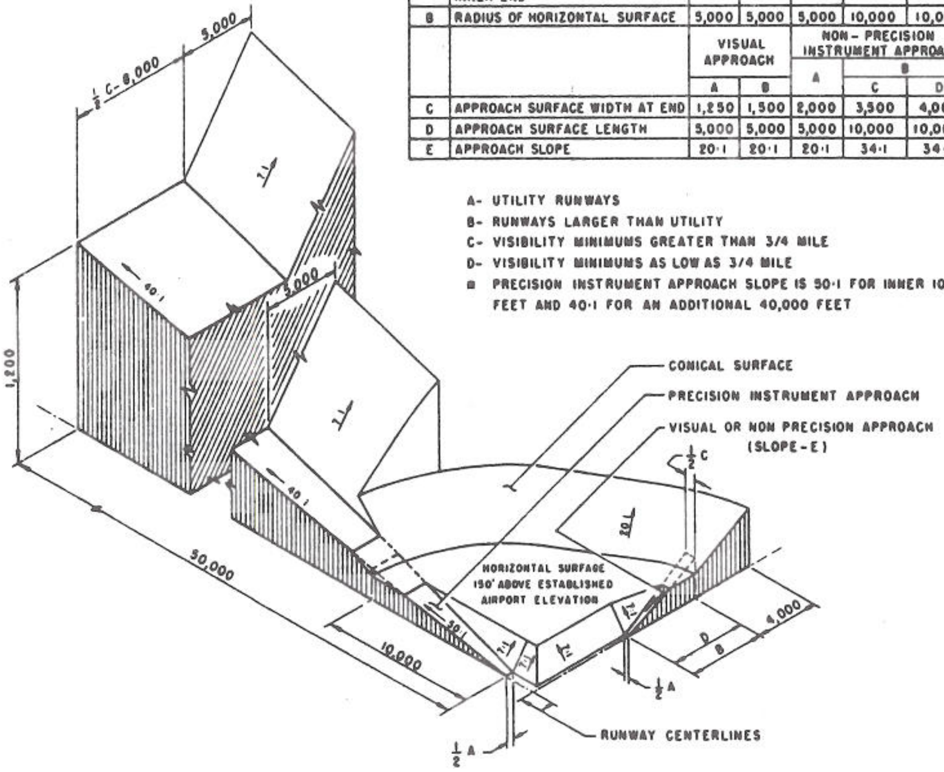
(c) *Heliport transitional surfaces.* These surfaces extend outward and upward from the lateral boundaries of the heliport primary surface and from the approach surfaces at a slope of 2 to 1 for a distance of 250 feet measured horizontally from the centerline of the primary and approach surfaces.

PART 77 **OBJECTS AFFECTING NAVIGABLE AIRSPACE**



DIM	ITEM	DIMENSIONAL STANDARDS (FEET)					
		VISUAL RUNWAY		NON-PRECISION INSTRUMENT RUNWAY			PRECISION INSTRUMENT RUNWAY
					B		
		A	B	A	C	D	
A	WIDTH OF PRIMARY SURFACE AND APPROACH SURFACE WIDTH AT INNER END	250	500	500	500	1,000	1,000
B	RADIUS OF HORIZONTAL SURFACE	5,000	5,000	5,000	10,000	10,000	10,000
		VISUAL APPROACH		NON-PRECISION INSTRUMENT APPROACH			PRECISION INSTRUMENT APPROACH
					B		
		A	B	A	C	D	
C	APPROACH SURFACE WIDTH AT END	1,250	1,500	2,000	3,500	4,000	16,000
D	APPROACH SURFACE LENGTH	5,000	5,000	5,000	10,000	10,000	*
E	APPROACH SLOPE	20:1	20:1	20:1	34:1	34:1	*

A- UTILITY RUNWAYS
B- RUNWAYS LARGER THAN UTILITY
C- VISIBILITY MINIMUMS GREATER THAN 3/4 MILE
D- VISIBILITY MINIMUMS AS LOW AS 3/4 MILE
* PRECISION INSTRUMENT APPROACH SLOPE IS 50:1 FOR INNER 10,000 FEET AND 40:1 FOR AN ADDITIONAL 40,000 FEET



ISOMETRIC VIEW OF SECTION A-A

§ 77.25 CIVIL AIRPORT IMAGINARY SURFACES

Notice of Proposed Construction or Alteration
FAA Form 7460

DO NOT REMOVE CARBONS

Form Approved OMB No. 2120-0001

US Department of Transportation
Federal Aviation Administration

NOTICE OF PROPOSED CONSTRUCTION OR ALTERATION

Aeronautical Study Number

1. Nature of Proposal

A. Type	B. Class	C. Work Schedule Dates
☐ New Construction	☐ Permanent	Beginning ______
☐ Alteration	☐ Temporary (Duration ______ months)	End ______

3A. Name and address of individual, company, corporation, etc. proposing the construction or alteration. *(Number, Street, City, State and Zip Code)*

( ) ______
area code Telephone Number

B. Name, address and telephone number of proponent's representative if different than 3 above

2. Complete Description of Structure

A. Include effective radiated power and assigned frequency of all existing, proposed or modified AM, FM, or TV broadcast stations utilizing this structure

B. Include size and configuration of power transmission lines and their supporting towers in the vicinity of FAA facilities and public airports

C. Include information showing site orientation, dimensions and construction materials of the proposed structure

(If more space is required, continue on a separate sheet.)

4. Location of Structure

A. Coordinates (To nearest second)	B. Nearest City or Town, and State	C. Name of nearest airport, heliport, flightpark or seaplane base
° ' " Latitude	(1) Distance to 4B Miles	(1) Distance from structure to nearest point of nearest runway
° ' " Longitude	(2) Direction to 4B	(2) Direction from structure to airport

5. Height and Elevation *(Complete to the nearest foot)*

A. Elevation of site above mean sea level	
B. Height of Structure including all appurtenances and lighting *(if any)* above ground, or water if so situated	
C. Overall height above mean sea level *(A + B)*	

D. Description of location of site with respect to highways, streets, airports, prominent terrain features, existing structures, etc. Attach a U.S. Geological Survey quadrangle map or equivalent showing the relationship of construction site to nearest airport(s). *(If more space is required, continue on a separate sheet of paper and attach to this notice.)*

Notice is required by Part 77 of the Federal Aviation Regulations (14 C.F.R. Part 77) pursuant to Section 1101 of the Federal Aviation Act of 1958, as amended (49 U.S.C. 1101). Persons who knowingly and willingly violate the Notice requirements of Part 77 are subject to a fine (criminal penalty) of not more than $500 for the first offense and not more than $2,000 for subsequent offenses, pursuant to Section 902(a) of the Federal Aviation Act of 1958, as amended (49 U.S.C. 1472(a)).

I HEREBY CERTIFY that all of the above statements made by me are true, complete, and correct to the best of my knowledge. In addition, I agree to obstruction mark and/or light the structure in accordance with established marking & lighting standards if necessary.

Date	Typed Name/Title of Person Filing Notice	Signature

FOR FAA USE ONLY *FAA will either return this form or issue a separate acknowledgement.*

The Proposal:

☐ Does not require a notice to FAA.

☐ Is not identified as an obstruction under any standard of FAR, Part 77, Subpart C, and would not be a hazard to air navigation.

☐ Is identified as an obstruction under the standards of FAR, Part 77, Subpart C, but would not be a hazard to air navigation.

☐ Should be obstruction ☐ marked, ☐ lighted per FAA Advisory Circular 70/7460-1, Chapter (s) ______

☐ Obstruction marking and lighting are not necessary.

Remarks:

Supplemental Notice of Construction FAA Form 7460-2 is required any time the project is abandoned, or

☐ At least 48 hours before the start of construction.

☐ Within five days after the construction reaches its greatest height.

This determination expires on ______ unless:

(a) extended, revised or terminated by the issuing office;

(b) the construction is subject to the licensing authority of the Federal Communications Commission and an application for a construction permit is made to the FCC on or before the above expiration date. In such case the determination expires on the date prescribed by the FCC for completion of construction, or on the date the FCC denies the application.

NOTE: Request for extension of the effective period of this determination must be postmarked or delivered to the issuing office at least 15 days prior to the expiration date.

If the structure is subject to the licensing authority of the FCC, a copy of this determination will be sent to that Agency.

Issued In	Signature	Date

FAA Form 7460-1

DO NOT REMOVE CARBONS

Airport Design Standards
FAA Advisory Circular No. 150/5300-13

Table 2-4. Approach surface dimensions

Facilities Expected To Serve	Runway End: Approach End	Runway End: Opposite End	Approach Surface Dimensions: Length feet (meters)	Inner Width feet (meters)	Outer Width feet (meters)	Slope run/rise
Only Small Airplanes	V	V	5,000 (1 500)	250 (75)	1,250 (375)	20:1
		NP	5,000 (1 500)	500 (150)	1,250 (375)	20:1
		NP 3/4 P	5,000 (1 500)	1,000 (300)	1,250 (375)	20:1
	NP	V NP	5,000 (1 500)	500 (150)	2,000 (600)	20:1
		NP 3/4 P	5,000 (1 500)	1,000 (300)	2,000 (600)	20:1
Large Airplanes	V	V NP	5,000 (1 500)	500 (150)	1,500 (450)	20:1
		NP 3/4 P	5,000 (1 500)	1,000 (300)	1,500 (450)	20:1
	NP	V NP	10,000 (3 000)	500 (150)	3,500 (1 050)	34:1
		NP 3/4 P	10,000 (3 000)	1,000 (300)	3,500 (1 050)	34:1
Large or Only Small Airplanes	NP 3/4	V NP NP 3/4 P	10,000 (3 000)	1,000 (300)	4,000 (1 200)	34:1
	P	V NP NP 3/4 P	10,000 (3 000) PLUS 40,000 (12 000)	1,000 (300) 4,000 (1 200)	4,000 (1 200) 16,000 (4 800)	50:1 40:1

V - Visual approach

NP - Nonprecision instrument approach with visibility minimums more than 3/4-statute mile

NP 3/4 - Nonprecision instrument approach with visibility minimums as low as 3/4-statute mile

P - Precision instrument approach

Table 2-5. Runway protection zone (RPZ) dimensions

Facilities Expected To Serve	Runway End		Dimensions For Approach End			
	Approach End	Opposite End	Length L feet (meters)	Inner Width W_1 feet (meters)	Outer Width W_2 feet (meters)	RPZ acres
Only Small Airplanes	V	V	1,000 (300)	250 (75)	450 (135)	8.035
		NP	1,000 (300)	500 (150)	650 (195)	13.200
		NP 3/4 P	1,000 (300)	1,000 (300)	1,050 (315)	23.542
	NP	V NP	1,000 (300)	500 (150)	800 (240)	14.922
		NP 3/4 P	1,000 (300)	1,000 (300)	1,200 (360)	25.252
Large Airplanes	V	V NP	1,000 (300)	500 (150)	700 (210)	13.770
		NP 3/4 P	1,000 (300)	1,000 (300)	1,100 (330)	24.105
	NP	V NP	1,700 (510)	500 (150)	1,010 (303)	29.465
		NP 3/4 P	1,700 (510)	1,000 (300)	1,425 (427.5)	47.320
Large or Only Small Airplanes	NP 3/4	V NP NP 3/4 P	1,700 (510)	1,000 (300)	1,510 (453)	48.978
	P	V NP NP 3/4 P	2,500 (750)	1,000 (300)	1,750 (525)	78.914

V = Visual approach
NP = Nonprecision instrument approach with visibility minimums more than 3/4-statute mile
NP 3/4 = Nonprecision instrument approach with visibility minimums as low as 3/4-statute mile
P = Precision instrument approach

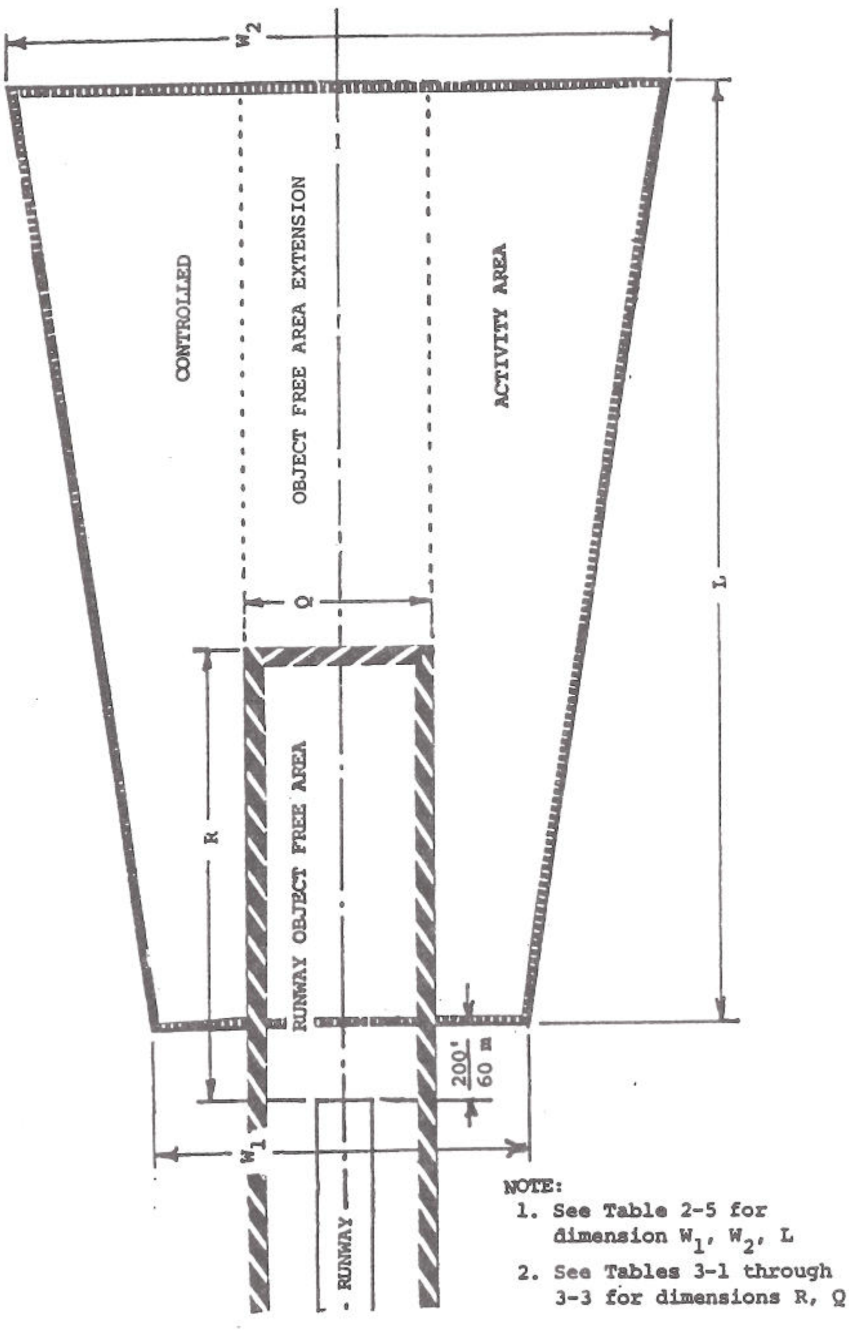


Figure 2-3. Runway protection zone

Appendix F

Reference Documents

Reference Documents

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Appendix G

Glossary of Terms

Appendix G
Glossary of Terms

Air Carriers: The commercial system of air transportation, consisting of the certificated air carriers, air taxis (including commuters), supplemental air carriers, commercial operators of large aircraft, and air travel clubs.

Air Installation Compatible Use Zone (AICUZ): A land use compatibility plan prepared by the U.S. Department of Defense for military airfields. AICUZ plans serve as recommendations to local government bodies having jurisdiction over land uses surrounding these facilities.

Aircraft Accident: An occurrence incident to flight in which, as a result of the operation of an aircraft, a person (occupant or nonoccupant) receives fatal or serious injury or an aircraft receives substantial damage.

- Except as provided below, *substantial damage* means damage or structural failure which adversely affects the structural strength, performance, or flight characteristics of the aircraft, and which would normally require major repair or replacement of the affected component.
- Engine failure, damage limited to an engine, bent fairings or cowling, dented skin, small puncture holes in the skin or fabric, ground damage to rotor or propeller blades, damage to landing gear, wheels, tires, flaps, engine accessories, brakes, or wingtips are not considered substantial damage.

Aircraft Incident: A mishap associated with the operation of an aircraft in which neither fatal or serious injuries nor substantial damage to the aircraft occur.

Aircraft Mishap: The collective term for an aircraft accident or an incident.

Aircraft Operation: The airborne movement of aircraft in controlled or noncontrolled airport terminal areas and about a given en route fixes or at other points where counts can be made. There are two types of operations - local and itinerant. An operation is counted for each landing and each departure, such that a touch-and-go flight is counted as two operations. (FAA Stats)

Airport: An area of land or water that is used or intended to be used for the landing and taking off of aircraft, and includes its buildings and facilities, if any. (FAR 1)

Airport Elevation: The highest point of an airport's usable runways, measured in feet above mean sea level. (AIM)

Note: See end of Glossary for list of sources.

Airport Land Use Commission (ALUC): A commission authorized under the provisions of California Public Utilities Code, Sections 21670 et seq. and established (in any county within which a public-use airport is located) for the purpose of promoting compatibility between airports and the land uses surrounding them.

Airport Layout Plan (ALP): A scale drawing of existing and proposed airport facilities, their location on an airport, and the pertinent clearance and dimensional information required to demonstrate conformance with applicable standards.

Airport Master Plan (AMP): A long-range plan for development of an airport, including descriptions of the data and analyses on which the plan is based.

Airport Reference Code (ARC): A coding system used to relate airport design criteria to the operational and physical characteristics of the airplanes intended to operate at an airport. (Airport Design AC)

Airports, Classes of: For the purposes of issuing a Site Approval Permit, the California Division of Aeronautics classifies airports into the following categories. (CAC)

- *Agricultural Airport or Heliport:* An airport restricted to use only by agricultural aerial applicator aircraft (FAR Part 137 Operators).

- *Emergency Medical Services (EMS) Landing Site:* A site at or as near as practical to a medical emergency; a transfer point; or a site at or near a medical facility preselected and approved by an officer authorized by a public safety agency, using criteria deemed reasonable and prudent by that public safety agency, used for the landing and taking off of EMS helicopters, but not designed or used exclusively for helicopter flight operations.

- *Heliport on Offshore Oil Platform:* A heliport located on a structure in the ocean, not connected to the shore by pier, bridge, wharf, dock, or breakwater, used in the support of petroleum exploration or production.

- *Personal-Use Airport:* An airport limited to the non-commercial use of an individual owner or family and an occasional invited guest.

- *Public-Use Airport:* A publicly or privately owned airport that offers the use of its facilities to the public without prior notice or special invitation or clearance and that has been issued a California Airport Permit by the Division of Aeronautics of the California Department of Transportation.

- *Seaplane Landing Site:* An area of water used, or intended for use, for landing and taking off of seaplanes.

- *Special-Use Airport or Heliport:* An airport not open to the general public, access to which is controlled by the owner in support of commercial activities, public services and/or personal use.

- *Temporary Helicopter Landing Site:* A site for purposes other than emergency medical service operations which is used, but not exclusively, for landing and taking off of helicopters. These sites are generally limited to one year, except for recurrent annual events and public safety agency operations. No site may be used as a temporary helicopter landing site except in an emergency, or unless it is in accordance with 14 CFR (FARs), Public Utilities Code 21000, et seq. and local ordinances.

Ambient Noise Level: The level of noise that is all-encompassing within a given environment for which a single source cannot be determined. It is usually a composite of sounds from many and varied sources near to and far from the receiver.

Approach Protection Easement: A form of easement which both conveys all of the rights of an avigation easement and sets specified limitations on the type of land uses allowed to be developed on the property.

Approach Speed: The recommended speed contained in aircraft manuals used by pilots when making an approach to landing. This speed will vary for different segments of an approach as well as for aircraft weight and configuration. (AIM)

Avigation Easement: A type of easement which typically conveys the following rights:

- A right-of-way for free and unobstructed passage of aircraft through the airspace over the property at any altitude above a surface specified in the easement (usually set in accordance with FAR Part 77 criteria).

- A right to subject the property to noise, vibrations, fumes, dust, and fuel particle emissions associated with normal airport activity.

- A right to prohibit the erection or growth of any structure, tree, or other object that would enter the acquired airspace.

- A right-of-entry onto the property, with proper advance notice, for the purpose of removing, marking, or lighting any structure or other object that enters the acquired airspace.

- A right to prohibit electrical interference, glare, misleading lights, visual impairments, and other hazards to aircraft flight from being created on the property.

Based Aircraft: Aircraft stationed at an airport on a long-term basis.

California Environmental Quality Act (CEQA): Statutes adopted by the state legislature for the purpose of maintaining a quality environment for the people of the state now and in the future. The Act establishes a process for state and local agency review of projects, as defined in the implementing guidelines, which may adversely affect the environment.

Ceiling: Height above the earth's surface to the lowest layer of clouds or obscuring phenomena. (AIM)

Circling Approach/Circle to Land Maneuver: A maneuver initiated by the pilot to align the aircraft with a runway for landing when a straight-in landing from an instrument approach is not possible or not desirable. (AIM)

Combining District: A zoning district which establishes development standards in areas of special concern over and above the standards applicable to basic underlying zoning districts.

Commercial Activities: Airport-related activities which may offer a facility, service or commodity for sale, hire or profit. Examples of commodities for sale are: food, lodging, entertainment, real estate, petroleum products, parts and equipment. Examples of services are: flight training, charter flights, maintenance, aircraft storage and tie-down. (CAC)

Commercial Operator: A person who, for compensation or hire, engages in the carriage by aircraft in air commerce of persons or property, other than as an air carrier. (FAR 1)

Community Noise Equivalent Level (CNEL): The noise metric adopted by the State of California for evaluating airport noise. It represents the average daytime noise level during a 24-hour day, adjusted to an equivalent level to account for the lower tolerance of people to noise during evening and nighttime periods relative to the daytime period. (State Airport Noise Standards)

Compatibility Plan: As used herein, a plan, usually adopted by an Airport Land Use Commission, which sets forth policies for promoting compatibility between airports and the land uses which surround them. Often referred to as a *Comprehensive Land Use Plan (CLUP)*.

Control Zone: Controlled airspace surrounding one or more airports, normally a circular area having a radius of five statute miles plus extensions to include instrument arrival and departure paths. Most control zones surround airports with air traffic control towers and are in effect only for the hours when the tower is operational.

Controlled Airspace: Any of several types of airspace within which some or all aircraft may be subject to air traffic control. (FAR 1)

Day-Night Average Sound Level (DNL): The noise metric adopted by the U.S. Environmental Protection Agency for measurement of environmental noise. It represents the average daytime noise level during a 24-hour day, measured in decibels and adjusted to account for the lower tolerance of people to noise during nighttime periods. The mathematical symbol is L_{dn}.

Decibel (dB): A unit measuring the magnitude of a sound, equal to the logarithm of the ratio of the intensity of the sound to the intensity of an arbitrarily chosen standard sound, specifically a sound just barely audible to an unimpaired human ear. For environmental noise from aircraft and other transportation sources, an *A-weighted sound level* (sometimes abbreviated dBA) is normally used. The A-weighting scale adjusts the values of different sound frequencies to approximate the auditory sensitivity of the human ear.

Deed Notice: A formal statement added to the legal description of a deed to a property and on any subdivision map. As used in airport land use planning, a deed notice would state that the property is subject to aircraft overflights. Deed notices are used as a form of buyer notification as a means of ensuring that those who are particularly sensitive to aircraft overflights can avoid moving to the affected areas.

Density of Use: As used in airport land use planning, the term refers to the number of dwelling units per gross acre for residential land uses or the number of people per acre with regard to other land uses.

Designated Body: A local government entity, such as a regional planning agency or a county planning commission, chosen by the county board of supervisors and the selection committee of city mayors to act in the capacity of an airport land use commission.

Displaced Threshold: A landing threshold that is located at a point on the runway other than the designated beginning of the runway (see *Threshold*). (AIM)

Easement: A less-than-fee-title transfer of real property rights from the property owner to the holder of the easement.

Equivalent Sound Level (L_{eq}): The level of constant sound which, in the given situation and time period, has the same average sound energy as does a time-varying sound.

FAR Part 77: The part of the Federal Aviation Regulations which deals with objects affecting navigable airspace.

FAR Part 77 Surfaces: Imaginary airspace surfaces established with relation to each runway of an airport. There are five types of surfaces: (1) primary; (2) approach; (3) transitional; (4) horizontal; and (5) conical.

Federal Aviation Administration (FAA): The U.S. government agency which is responsible for ensuring the safe and efficient use of the nation's airports and airspace.

Federal Aviation Regulations (FAR): Regulations formally issued by the FAA to regulate air commerce.

Findings: Legally relevant subconclusions which expose a government agency's mode of analysis of facts, regulations, and policies, and which bridge the analytical gap between raw data and ultimate decision.

Fixed Base Operator (FBO): A business which operates at an airport and provides aircraft services to the general public, including but not limited to sale of fuel and oil; aircraft sales, rental, maintenance, and repair; parking and tiedown or storage of aircraft; flight training; air taxi/charter operations; and specialty services, such as instrument and avionics maintenance, painting, overhaul, aerial application, aerial photography, aerial hoists, or pipeline patrol.

General Aviation: That portion of civil aviation which encompasses all facets of aviation except air carriers. (FAA Stats)

Glide Slope: An electronic signal radiated by a component of an ILS to provide vertical guidance for aircraft during approach and landing.

Global Positioning System (GPS): A satellite-based radio positioning, navigation, and time-transfer system developed and used by the U.S. Department of Defense. This technology may eventually become the principal system for air navigation throughout the world.

Helipad: A small, designated area, usually with a prepared surface, on a heliport, airport, landing/takeoff area, apron/ramp, or movement area used for takeoff, landing, or parking of helicopters. (AIM)

Heliport: A site used for the landing and taking off of helicopters which consists of a takeoff and landing area, helipad/helideck, approach-departure paths, heliport imaginary surfaces, a functioning wind cone, and sufficient lighting.

Infill: Development which takes place on vacant property largely surrounded by existing development, especially development which is similar in character.

Instrument Approach Procedure: A series of predetermined maneuvers for the orderly transfer of an aircraft under instrument flight conditions from the beginning of the initial approach to a landing or to a point from which a landing may be made visually. It is prescribed and approved for a specific airport by competent authority (refer to *Nonprecision Approach Procedure* and *Precision Approach Procedures*). (AIM)

Instrument Flight Rules (IFR): Rules governing the procedures for conducting instrument flight. Generally, IFR applies when meteorological conditions with a ceiling below 1,000 feet and visibility less than 3 miles prevail. (AIM)

Instrument Landing System (ILS): A precision instrument approach system which normally consists of the following electronic components and visual aids: (1) localizer; (2) Glide Slope; (3) Outer Marker; (4) Middle Marker; (5) Approach Lights. (AIM)

Instrument Operation: An aircraft operation in accordance with an IFR flight plan or an operation where IFR separation between aircraft is provided by a terminal control facility. (FAA ATA)

Instrument Runway: A runway equipped with electronic and visual navigation aids for which a precision or nonprecision approach procedure having straight-in landing minimums has been approved. (AIM)

Inverse Condemnation: An action brought by a property owner seeking just compensation for land taken for a public use against a government or private entity having the power of eminent domain. It is a remedy peculiar to the property owner and is exercisable by that party where it appears that the taker of the property does not intend to bring eminent domain proceedings.

Large Airplane: An airplane of more than 12,500 pounds maximum certificated takeoff weight. (Airport Design AC)

Localizer (LOC): The component of an ILS which provides course guidance to the runway. (AIM)

Minimum Descent Altitude (MDA): The lowest altitude, expressed in feet above mean sea level, to which descent is authorized on final approach or during circle-to-land maneuvering in execution of a standard instrument approach procedure where no electronic glide slope is provided. (FAR 1)

Missed Approach: A maneuver conducted by a pilot when an instrument approach cannot be completed to a landing. (AIM)

National Transportation Safety Board (NTSB): The U.S. government agency responsible for investigating transportation accidents and incidents.

Navigational Aid (Navaid): Any visual or electronic device airborne or on the surface which provides point-to-point guidance information or position data to aircraft in flight. (AIM)

Noise Contours: Continuous lines of equal noise level usually drawn around a noise source, such as an airport or highway. The lines are generally drawn in 5-decibel increments so that they resemble elevation contours in topographic maps.

Noise Level Reduction: A measure used to describe the reduction in sound level from environmental noise sources occurring between the outside and the inside of a structure.

Nonconforming Use: An existing land use which does not conform to subsequently adopted or amended zoning or other land use development standards.

Nonprecision Approach Procedure: A standard instrument approach procedure in which no electronic glide slope is provided. (FAR 1)

Nonprecision Instrument Runway: A runway with an approved or planned straight-in instrument approach procedure which has no existing or planned precision instrument approach procedure. (Airport Design AC)

Obstruction: Any object of natural growth, terrain, or permanent or temporary construction or alteration, including equipment or materials used therein, the height of which exceeds the standards established in Subpart C of Federal Aviation Regulations Part 77, *Objects Affecting Navigable Airspace*.

Overflight: Any distinctly visible and audible passage of an aircraft in flight, not necessarily directly overhead.

Overflight Easement: An easement which describes the right to overfly the property above a specified surface and includes the right to subject the property to noise, vibrations, fumes and emissions. An overflight easement is used primarily as a form of buyer notification.

Overflight Zone: The area(s) where aircraft maneuver to enter or leave the traffic pattern, typically defined by the FAR Part 77 horizontal surface.

Overlay Zone: See *Combining District*.

Planning Area Boundary: An area surrounding an airport designated by an ALUC for the purpose of airport land use compatibility planning conducted in accordance with provisions of the State Aeronautics Act.

Precision Approach Procedure: A standard instrument approach procedure where an electronic glide slope is provided. (FAR 1)

Precision Instrument Runway: A runway with an existing or planned precision instrument approach procedure. (Airport Design AC)

Referral Area: The area around an airport defined by the planning area boundary adopted by an Airport Land Use Commission within which certain land use proposals are to be referred to the commission for review.

Runway Protection Zone (RPZ): An area (formerly called a *clear zone*) off the end of a runway used to enhance the protection of people and property on the ground. (Airport Design AC)

Safety Zone: For the purpose of airport land use planning, an area near an airport in which land use restrictions are established to protect the safety of the public from potential aircraft accidents.

Single-Event Noise: As used in herein, the noise from an individual aircraft operation or overflight.

Single Event Noise Exposure Level (SENEL): A measure, in decibels, of the noise exposure level of a single event, such as an aircraft flyby, measured over the time interval between the initial and final times for which the noise level of the event exceeds a threshold noise level and normalized to a reference duration of one second. SENEL is a noise metric established for use in California by the state Airport Noise Standards and is essentially identical to *Sound Exposure Level (SEL).*

Site Approval Permit: A written approval issued by the California Department of Transportation Division of Aeronautics authorizing construction of an airport in accordance with approved plans, specifications and conditions. Both public-use and special-use airports require a site approval permit. (CAC)

Small Airplane: An airplane of 12,500 pounds or less maximum certificated takeoff weight. (Airport Design AC)

Sound Exposure Level (SEL): A time-integrated metric (i.e., continuously summed over a time period) which quantifies the total energy in the A-weighted sound level measured during a transient noise event. The time period for this measurement is generally taken to be that between the moments when the A-weighted sound level is 10 dB below the maximum.

Straight-In Instrument Approach: An instrument approach wherein a final approach is begun without first having executed a procedure turn; it is not necessarily completed with a straight-in landing or made to straight-in landing weather minimums. (AIM)

Taking: Government appropriation of private land for which compensation must be paid as required by the First Amendment of the U.S. Constitution. It is not essential that there be physical seizure or appropriation for a *taking* to occur, only that the government action directly interferes with or substantially disturbs the owner's right to use and enjoyment of the property.

Terminal Instrument Procedures (TERPS): Procedures for instrument approach and departure of aircraft to and from civil and military airports. There are four types of terminal instrument procedures: precision approach, nonprecision approach, circling, and departure.

Threshold: The beginning of that portion of the runway usable for landing (also see *Displaced Threshold*). (AIM)

Touch-and-Go: An operation by an aircraft that lands and departs on a runway without stopping or exiting the runway. (AIM)

Traffic Pattern: The traffic flow that is prescribed for aircraft landing at, taxiing on, or taking off from an airport. The components of a typical traffic pattern are upwind leg, crosswind leg, downwind leg, base leg, and final approach. (AIM)

Visual Approach: An approach where the pilot must use visual reference to the runway for landing under VFR conditions.

Visual Flight Rules (VFR): Rules that govern the procedures for conducting flight under visual conditions. VFR applies when meteorological conditions are equal to or greater than the specified minimum-generally, a 1,000-foot ceiling and 3-mile visibility.

Visual Runway: A runway intended solely for the operation of aircraft using visual approach procedures, with no straight-in instrument approach procedure and no instrument designation indicated on an FAA-approved airport layout plan. (Airport Design AC)

Zoning: A police power measure, enacted primarily by units of local government, in which the community is divided into districts or zones within which permitted and special uses are established, as are regulations governing lot size, building bulk, placement, and other development standards. Requirements vary from district to district, but they must be uniform within districts. A zoning ordinance consists of two parts: the text and a map.

Glossary Sources

FAR 1: *Federal Aviation Regulations Part 1, Definitions and Abbreviations.*

AIM: *Airmen's Information Manual* (1993).

Airport Design AC: Federal Aviation Administration, *Airport Design* Advisory Circular 150/5300-13. (1993)

CAC: California Administrative Code, Title 21, *Division of Aeronautics.*

FAA ATA: Federal Aviation Administration, *Air Traffic Activity.*

FAA Stats: Federal Aviation Administration, *Statistical Handbook of Aviation.*

NTSB: National Transportation and Safety Board.

Appendix H

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